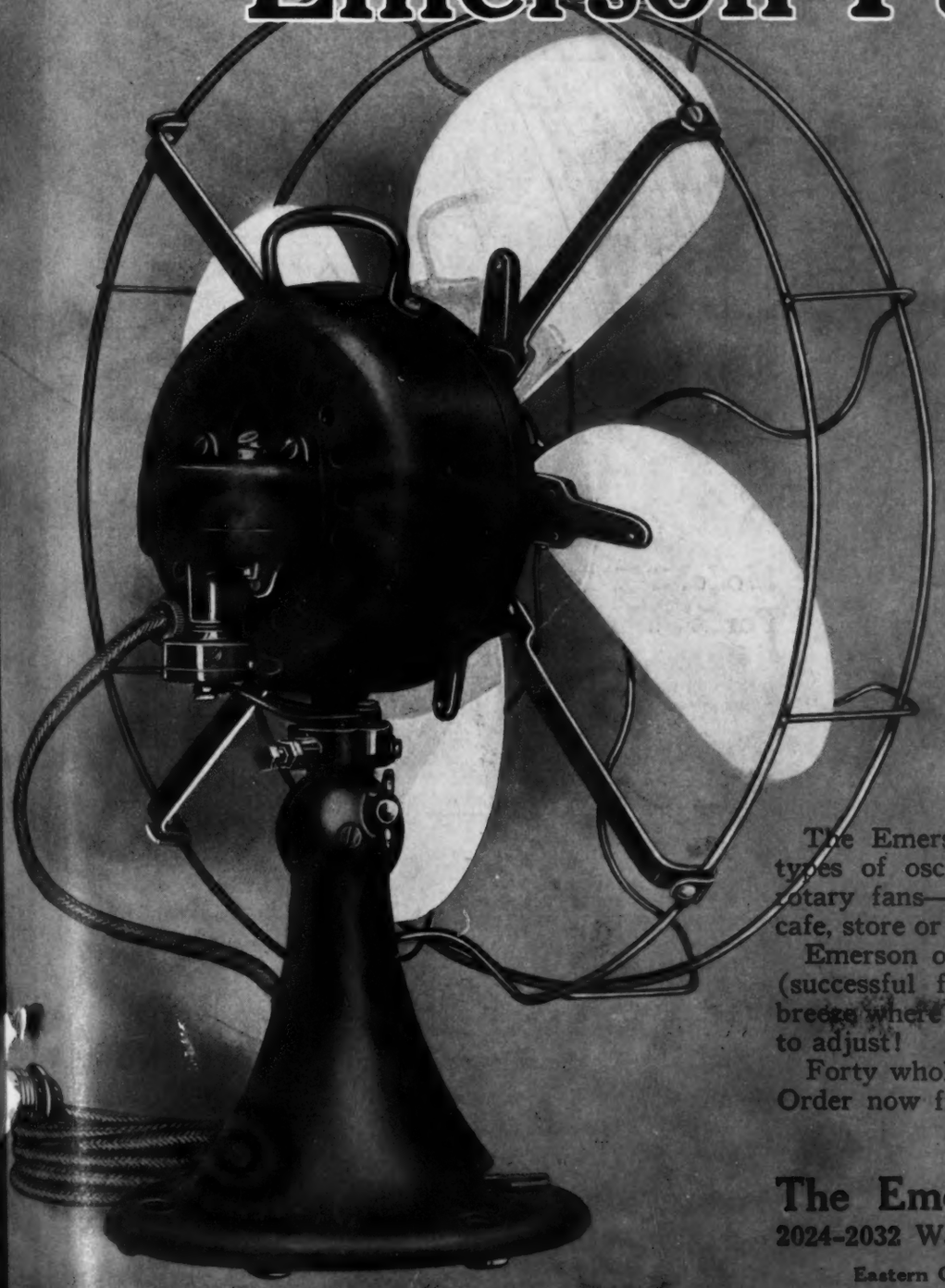
*Electrical Features of a New England Cotton Mill*—*Suggestions for a Government Hydroelectric Nitrate Plant and the Regular Departments Devoted to Operating Practice and Central-Station Management*

APR 2 1917
McGraw
Engineering Library

# Electrical World

New York, March 31, 1917 McGraw-Hill Publishing Co., Inc. Vol. 69, No. 13 10c a copy


## Emerson Fans



*"The Fans with the 5-year factory-to-user Guarantee"*

Thousands of fan buyers will look for the Emerson 5-year guarantee this summer. It is the indisputable evidence of the *extra* responsibility the manufacturer assumes. National advertising will again tell the public about it.

Will you turn these buyers away when they come into your store?

The Emerson line includes three dozen stock types of oscillating, non-oscillating, ceiling and rotary fans—types for the home, office, factory, cafe, store or hotel.

Emerson oscillators have the adjustable device (successful for three seasons) which puts the breeze where you want it—no others so convenient to adjust!

Forty wholesalers carry Emerson fans in stock. Order now from your wholesale dealer or write

**The Emerson Electric Mfg. Co.**
2024-2032 Washington Ave., St. Louis, Mo.
Eastern Office: 50 Church Street, New York City

# *Service—The Supreme Aim*

IT is our conviction that the success of an industrial or commercial organization—as of a man—can be measured only by the value of its service to mankind.

**Weston**

## Indicating Instruments

have played a leading, often an indispensable, part in the advances made since 1888 in every field of electrical achievement. Today, as at every previous stage of their steady progress toward perfection, they stand alone as the highest attainment in the Art of Electrical Measurement.

### Model 341 A.C. and D.C. Portable Voltmeter

This group also comprises Model 310 Single Phase and D. C. Wattmeter, Model 329 Polyphase Wattmeter and Model 370 A. C. and D. C. Ammeter.

Weston Models include complete groups for Portable and for Switchboard Service on A. C. and on D. C. circuits, together with many instruments designed for special purposes. Write for particulars regarding any field.

**Weston Electrical Instrument Co.**
**13 Weston Avenue, Newark, N. J.**

New York, Buffalo, Cleveland, Cincinnati, Boston, Philadelphia, Pittsburgh, Richmond, Chicago, St. Louis, Detroit, Denver, San Francisco, Toronto, Winnipeg, Vancouver, Montreal, London, Paris, Petrograd, Florence, Johannesburg, South Africa

# Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN
Published by the McGraw-Hill Publishing Company, Inc.

Vol. 69 NEW YORK, SATURDAY, MARCH 31, 1917 No. 13

## Borrowing Now

INTEREST on borrowed money is always a large item in the utility, which has to invest heavily in proportion to turnover. But it can be made still greater by borrowing in times of crisis just as it can be lightened by borrowing in periods of ease and confidence. When we make a great improvement we can afford to think in terms of hundreds of thousands or millions. When we sell the bonds to meet the cost we can afford to split eighths or sixteenths of 1 per cent with the banker. The operator who knows is the one who calculates the last dollar of cost. The unthinking man is the one who does not give much concern to price but passes the responsibility on to future years. Now is a time when the central station executive who plans ahead is considering capital requirements, present and probable, and economical means of providing for them. In seeking money he is competing with highly profitable industrial organizations, which promise a larger return than the public will let him give. He is hampered by reluctance of the public to let him have profits comparable with the huge profits of industrial properties. But he offers a stability in gross earning power which those properties lack and is forehanded in disposing of securities while the banking and public buying power is good.

---

## Radio-Communication in War

THE present great war is an event of more importance than any in human history since the fall of the Roman Empire. All of Europe except a few of the smaller powers is fighting. All Asia is in the lists. Part of North America—that is, Canada—is already fighting officially, and the rest of North America—the United States and Mexico—are virtually in the war, although still unofficially. All Australia and Australasia are involved, and South America may soon follow, because the fence between the belligerents is too narrow and sharp to permit of comfortable sitting.

It has until recently been generally accepted that any alliance of nations which could maintain dominion on the seas could ultimately extend its dominion over the lands. It now looks as though the dominion of the air would ultimately transcend in importance the dominion of the sea. The dominion of the air is obtained by flying machines and by radio-communication. Those nations which collectively can maintain in alliance the greatest skill and ability in fleets of aeroplanes, and also the greatest skill and ability in radio-communication, may be expected jointly to retain command of the seas, and in combination therewith to maintain command of the land. This skill and ability is intellectual and moral. It calls for a high degree of inventiveness, engineering, discipline, hardihood, courage and initiative. No single country can expect to maintain such a hegemony, but a strong federation of progressive countries may hope to keep the peace of the world through the joint dominion of the air.

---

## Expanding Manufacturing Plant

EXPANSION in manufacturing plant does not keep step with expansion in orders. One goes faster than the other, and sometimes it is plant which leads while in other periods it is the orders that outstrip the enlargement in physical capacity. In the electrical manufacturing industries the controlling judgment on the wisdom of extensive plant expansion is partially suspended because of the strangely conflicting influences and uncertainties of the day. It takes far-sighted courage to decide upon and prosecute a program of expansion in keeping with the indicated volume of orders this year. The price of not doing it, however, is lost orders and disappointed customers, provided, of course, the business tide remains at high level. The manufacturer turns to the other side of the picture and sees arrayed in argument against expansion such major points as high building cost, material scarcity, labor independence, and then the present waiting position of the country. Plant capacity is being used to-day to the full possible limit, shop rearrangement is promoting increase of output, but actual expansion is still far behind the gain in volume of business. The expansion of plant will follow and the long period of prosperity will make its financing easier.

---

## The Lightning Peril

EVERY power transmission plant has a wholesome fear of Thor's hammer. It is the most uncontrollable factor in the situation. With growing experience valuable information regarding it has accumulated, and important remedial action has been taken, yet lack of complete knowledge of the practical phases of the situation has hampered the course of adequate defence. A brief paper by C. W. Piper in this issue constitutes a not unimportant addition to our knowledge of a difficult subject, in that it summarizes, over a territory including thirteen states, the nature of the damage which has recently been done. The statistics of the matter show that, as might have been anticipated from the general trend of experience, transformers and

meters are the most frequent seats of damage, covering on the whole approximately half of the entire damage due to lightning. Both transformers and meters are numerous and particularly susceptible to injury, and a more thorough statistical investigation would probably show like results all over the country.

An interesting addition to the data would have been an analysis of damage with respect to the voltage of the lines. It seems to be rather a usual experience that increase of voltage does not proportionately increase the risk from lightning, owing to the greater absolute margin of safety in the insulation; but exact data on this matter would be most illuminating. For instance, next to transformers and meters insulators come in for the largest amount of damage, and it certainly is of vital interest to know the relation of this particular difficulty to the voltage of the lines. Further, has there been any material damage in cases where suspension insulators were used, and what was the margin of safety between the working voltage and the breaking point in cases where damage has been done? The facts collected seem thoroughly to have proved that lightning does strike twice in the same place, and indeed it is not difficult to find certain points on particular systems where trouble from lightning is exceptionally frequent and which require, and should receive, particularly good protection. The present trend of practice is to install a moderate number of arresters, placing them as near as possible to the apparatus to be protected and paying special attention to branches of the main line and to large and consequently valuable transformers. Whether it is possible entirely to avert damage from direct lightning strokes may perhaps be regarded as dubious, since the efficient voltage may be enormously great with respect to the factors of safety even with the best apparatus. On the other hand, the data collected seem to show that most of the damage done is by induced strokes or their resulting surges, which are of relatively moderate voltage and hence much more easily dealt with.

In attempting anything like complete protection the cost of the arresting devices themselves rises to a very serious amount, and a balance has to be struck between the cost of arresters, the damage due to interruptions and the probable interruptions due to failure of insulation. It is a situation somewhat akin to that found in the installation of so-called automatic devices of many kinds. Used judiciously these are of vast value in the operation of an electric plant, but it is by no means impossible to reach a point where the automatic apparatus becomes itself a source of more practical difficulty than those things which it is installed to remedy. The final moral of this and other investigations into lightning is that in arranging protection hard common sense and experience, particularly the latter, count for a great deal, and that the fundamental rule in safeguarding a system is to pick out the danger points and to protect them, right there, by such means as seem adequately suited to the particular task. A bank of costly transformers justifies thorough, even if expensive, protection which would not be appropriate for apparatus of less cost and importance.

## Electric Cotton Mill Equipment

IT is now a little more than twenty years since the first complete electric drive for a cotton mill went into service at Columbia, S. C. One or two attempts had been made previously by the mere substitution of motor for steam plant in the general drive of the mill, but the Columbia installation marked an epoch inasmuch as group drive by induction motors was there for the first time instituted. In another column Mr. David Elwell gives an important report on the electric equipment of a great cotton mill at Salem, Mass., in which it was practicable to plan the whole installation from the ground up so as best to meet the somewhat intricate requirements of that particular industry. The case is more than usually striking because the energy, instead of being generated locally, as at many electrically driven mills, is purchased from the Salem Electric Lighting Company and is delivered at the regular 2300 volts working pressure of the power house. The area covered amounts to nearly twenty-three acres of floor space, and the whole power load rises to between 4000 kw. and 4500 kw., distributed to nearly 300 motors. These motors are of the ordinary three-phase type, and with the exception of the equipment of the weave shed are all wound for 550 volts, which has been from the very beginning a popular voltage for mill distribution on account of relatively small requirements for distribution copper. In the weave shed 220-volt motors were used, for the reason that motors specialized for such service have been widely developed for this particular pressure. This voltage also facilitates the switching equipment by allowing the use of standard and comparatively inexpensive devices.

A particularly interesting feature of the transformer installation is that it constitutes an outdoor substation protected by a concrete and steel roof and partly housed in by a brick fire wall. The transformer units themselves are mounted on steel rollers bearing on rails so that they can be moved readily and the floor is drained to take care of the oil in case of accident. Alongside this main substation is a wire tower, from which radiate the 2300-volt feeders for the subsidiary transformer banks and the heavy 550-volt power circuits for the spinning mill. The weave-shed power at the lower voltage is derived from five banks, each of 600 kva., and these transformer groups are energized from two separate 2300-volt power feeders. The lighting circuits are worked single-phase from balanced connections to three-phase transformers, or sometimes from connection to a single phase.

The wiring is in general run in concealed conduits for the lighting, and open for the power. The details of the installation are fully discussed by the author. From a practical standpoint the most striking feature of the installation is the fact that the energy is purchased on the basis of demand charge plus a meter charge, and that there are special requirements connected with this contract by which the mill has to maintain an 80 per cent power factor, even if synchronous condensers should be required to keep it up. In point of fact the power factor is about 82 per cent, and a little higher

when lighting service is on. The final proof of excellence is in the results, and it should here especially be noted that the plant has emphatically made good by reaching an efficiency of production altogether extraordinary and very near to the maximum theoretically possible for the mill machinery employed. This performance is certainly in itself a complete justification for the often-made, and proved, claim that electric equipment leads to the best attainable results in efficiency of operation.

## An Atomic Model

MATTER as known to our senses, on a small scale, comes in solid or in liquid particles—*i.e.*, in lumps. There is very strong theoretical evidence, however, that these perceptible lumps are aggregations of vast numbers of molecules, which, in a chemically pure substance, under uniform conditions, may be all alike. No one has ever seen a molecule, even in the microscope, but the shadows of large molecules are believed to be visible in the ultra-microscope. It is very hard to avoid belief in the existence of molecules. These latter are, in turn, believed to be formed of groups of atoms, the atom being the smallest portion of any single chemical substance which can exist independently. The word atom, in its Greek derivation, means that which cannot be cut or subdivided. Until recently it was supposed that the atom was the smallest possible subdivision of matter. Recently that supposition has been blown to atoms. Atoms are now believed to be aggregations of entities very much smaller, which are called electrons, because their electrical properties are so prominent. Two kinds of electrons are postulated; namely, positive and negative electrons. Of these, the behavior of negative electrons is the more easily recognized. All negative electrons are supposed to be exactly alike. Although negative electrons are so remotely beyond the resolving powers of the microscope, yet the electrical effects of single electrons are readily detectable in the physical laboratory. The atom then still retains its place as the smallest individual piece of a chemical substance; but the electron, of which all atoms are constructed, is now the smallest material entity of which we have any knowledge. It is also believed that all the forces which act upon electrons to bind them into an atom and to endow the properties of the atoms are purely electromagnetic forces; so that to understand an atom we must study electricity.

A very high degree of interest attaches to the investigation of the inward properties of atoms, not only from a purely scientific standpoint, but also from the standpoint of possible engineering applications. It seems evident that the store of electric energy in the structure of an atom is relatively very large, and is enormous with respect to the energy that atoms can liberate in forming chemical unions into molecules. For example, there is reason to believe that the energy inside atoms of carbon and atoms of oxygen is far greater than that which is released when these carbon atoms of coal burn with the oxygen atoms of the air. If, therefore, it were found possible to disrupt atoms under control, the energy released in the process might make modern fuels take a very subordinate place in the production and distribution of energy. However, the problem seems very difficult of solution. An atom has constitutional objections to being disrupted. Some heavy atoms, like those of uranium, thorium and radium, oblige us by undergoing occasional automatic disruption and with the concomitant liberation of relatively large stores of internal energy; but as yet we can neither hasten nor retard the process.

If we are to learn how to unlock the bonds that gird electrons into the structure of an atom, we must first deserve success by hard work in the study of atoms and their little ways. There is no royal road to knowledge, even into the heart of so minute a thing as an atom.

Various attempts have already been made to picture the structure of atoms and their component electrons. The best success so far has been obtained by representing the negative electrons as rotating in planetary rings about a positively charged center. On the extremely great astronomical scale we see that solar systems are built up as flats, or substantially in two dimensions, with planets revolving in nearly coincident planes about a central sun. In the opposite extremely small atomic scale it is supposed that atomic systems are also flats, with numerous electron planets revolving in planes about a center. It is doubted, however, whether the atomic center is more than a geometric center, and whether it is occupied by positive electrons. At all events, atomic models at present content themselves with the planet electrons and substitute for the central sun a central force which pulls the electrons inwards.

A recent and interesting atomic model, consisting of magnetized steel balls floating in rotating mercury, has been described by Prof. R. R. Ramsey in the *Philosophical Magazine* and is referred to in this week's Digest.

## The Coming Issues

IN the issue for April 7 several articles which are of particular interest from the public policy point of view will be published. One will discuss the enlargement of the activities of holding companies in the public utility industries. This outcome is clearly forecast by recent developments. Other articles will take up recent decisions by courts and public service commissions which are worth attention as indicating tendencies in regulation. The regular monthly compilation of central station earnings and energy output will also appear in that issue, in addition to the statistics gathered every year by the ELECTRICAL WORLD, showing the output, peak load and time of peak on the largest generating systems in America for the year 1916. In the second issue of April subjects of interest to station and operating engineers will be discussed. The engineering number which will appear April 21 will contain an article on making direct-current network calculations and dealing with the effects of adding new conductors.

# Electric Service in a Cotton Mill

## Considerations Which Influenced Selection of Equipment, Layout of Apparatus and Methods of Installing It, with Features of Distribution Circuits and Central Station Contract

BY DAVID ELWELL

Electrical Engineer Lockwood, Greene & Company, Boston, Mass.

HAVING been forced by the burning of its cotton mills in 1914 to re-equip throughout, and wishing to use its entire plant and operating force for industrial purposes and not any for the generation of motive power, the Naumkeag Steam Cotton Company, Salem, Mass., adopted motor drive and central station energy exclusively for operating its machinery. Instead of having to fit motors to certain machine layouts and installations, as usually happens when rehabilitating a plant, with uneconomical results, conditions made it possible to study the requirements and select the most suitable types of motors and control apparatus as well as the most economical layout. Pending the rebuilding and equipping of the plant motor-driven looms were installed in the storehouse, which had escaped destruction by fire, and were operated by central station energy to maintain as large a portion of normal production as possible. Some of the considerations which influenced the selection of the permanent equipment will be outlined in the following article in conjunction with descriptions of the apparatus, layout and methods of installing it.

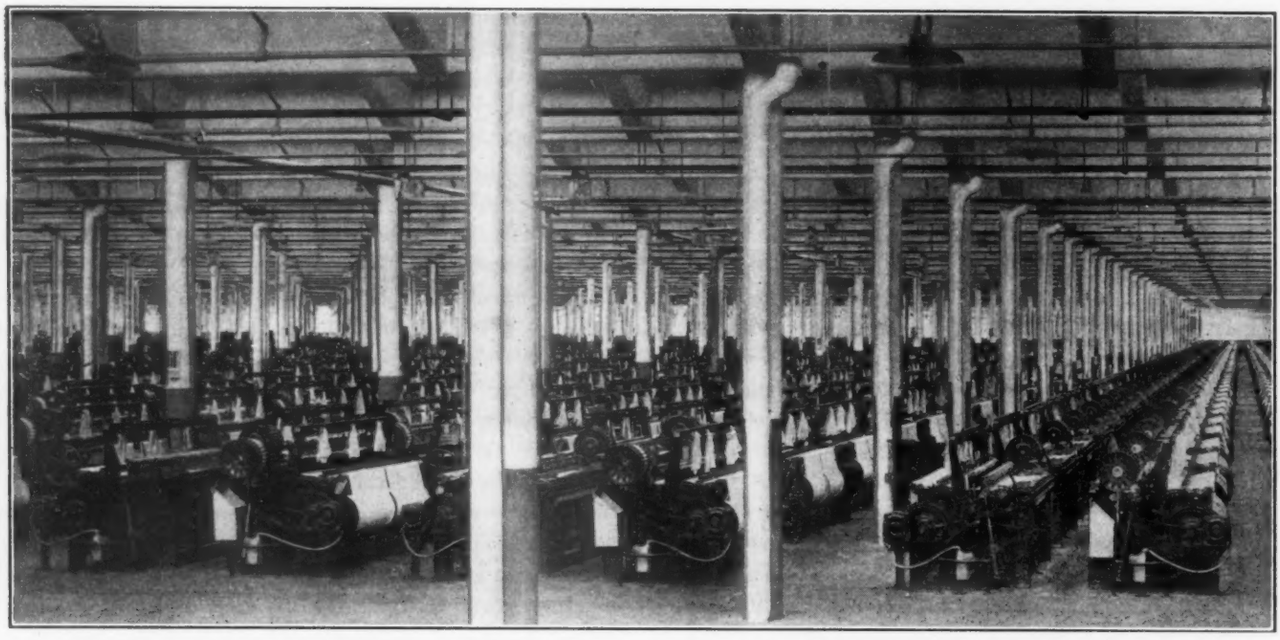


FIG. 1—WEAVE SHED OF NAUMKEAG STEAM COTTON COMPANY IN WHICH NEARLY 3000 SPECIAL LOOM MOTORS ARE INSTALLED

The new Naumkeag plant includes a storehouse, spinning mill, weave shed, and heating plant. In round figures, the plant has a total floor area of 1,000,000 sq. ft. Between the mill and storehouse basements, and also between the mill and the weave shed, are passageways which serve as thoroughfares and passages for pipes and electrical circuits.

Energy is furnished to the mill by the Salem Electric Lighting Company at 60 cycles and 2300 volts over four 500,000-circ. mil lead-covered, varnished-cambric, three-conductor cables laid in an underground duct line. At each end of each circuit is an oil circuit breaker, the switches at the station being equipped with inverse-time-element relays to prevent tripping from small peaks of short duration, and those at the mill with reverse energy relays to prevent energy feeding into a cable from both ends, in case of a fault in it.

### SELECTION OF VOLTAGES FOR DISTRIBUTION, MOTORS AND LIGHTING

Since 2300 volts is the standard distributing voltage of the Salem Electric Lighting Company, energy is received and distributed to the transformer groups at that potential. A pressure of 550 volts was selected for the mill and storehouse motors since this pressure was not considered absolutely hazardous, and would not necessitate the use of lead-covered cable and iron conduit as higher voltages would, owing to insurance requirements. Moreover, many of the motors are of small sizes which are not commercially available in voltages above 550. For the weave-shed equipment 220 volts was selected, since electrical manufacturers have specialized on this voltage for the type of motors used there. Furthermore, better efficiencies can be secured and failures in insulation are less likely than at higher voltages. Another point in favor of this voltage is that standard condulet fittings arranged for 220-volt snap switches are available for individual motor control, which would necessitate more expensive inclosed knife, or oil, switches if a higher voltage were used. Single-phase, 110-volt circuits balanced on the legs of three-phase, 2300/110-volt transformers were selected for lighting service.

On the south side of the mill is a wire tower from which radiate 2300-volt power feeders energizing the various transformer banks and 550-volt circuits serving the spinning mill. Intermediate floors have been provided half-way between the main floors in the tower on which the 550-volt power distributing boards serving

each mill floor are located. In the basement of the tower is located the electric service company's equipment as well as the 2300-volt mill distributing board.

The incoming 2300-volt cables enter this basement from an adjacent manhole and terminate at a two-panel board bearing oil circuit breakers with reverse-energy relays, graphic power-factor meters and wattmeters and duplicate watt-hour meters. This equipment controls all energy delivered to the mill and affords the necessary data for computing power bills on the basis mentioned later in the contract. From this board conductors lead to the buses of the mill distributing board adjoining the electric service company's panels. This board consists of five single-circuit feeder panels—one for mill and storehouse power supply, two for weave-shed power supply, one for mill and storehouse lighting, and one for weave-shed lighting.

The mill and storehouse power feeder consists of two three-phase, 500,000-circ. mil lead-covered, varnished-cambric cables connected in parallel to a bank of power transformers in an outdoor station adjacent to the wire tower. All of the remaining feeders are three-conductor, varnished-cambric, lead-covered, steel-taped underground cables. These were used because the mill and weave shed have dirt-floor basements in which they could be laid without excessive expense. Aerial power lines might have been used to the weave shed, but were undesirable because of appearance. Lead-covered cables in rigid iron conduit would have been more expensive

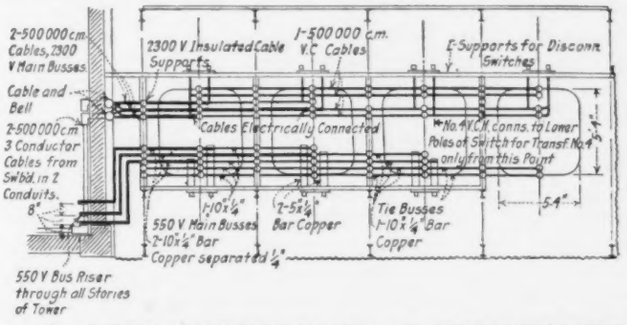

2-500 000 c.m. Cables, 2300 V Main Busses
Cable and Bell
2-500 000 c.m. 3 Conductor Cables from Swbd. in 2 Conduits.
8"
2300 V Insulated Cable Supports
1-500 000 c.m. V.C. Cables
E. Supports for Disconn. Switches
Cables Electrically Connected
No. 4 V.C.M. conns. to Lamar Poles at Switch for Transf. No. 4 only from this Point
5'-4"
5'-4"
1-10"x1/4" 550 V Main Busses 2-10"x1/4" Bar Copper separated 1/4"
2-5"x1/4" Bar Copper
Tie Busses 1-10"x1/4" Bar Copper
550 V Bus Riser through all Stories of Tower

FIG. 2—METHOD OF CONNECTING MILL AND STOREHOUSE POWER TRANSFORMERS, ONE OF WHICH IS A SPARE UNIT

than steel-taped underground cables. Underground fiber conduit installed outside the buildings would also have been expensive and might possibly interfere with future building extensions. A duct system laid in the building basements would have been inherently expensive and the cost of waterproofing or draining the duct lines and manholes would have been prohibitive since the basement floors are at high-water level, the plant being situated on Salem Harbor. Moreover, diagonal runs afforded the shortest circuits in the weave shed to the transformer vaults and were practicable only with steel-taped cables since interference with the column footings, which are about 25 ft. apart, had to be avoided.

The storehouse power load consists of two 15-hp. motors operating electric elevators and two 5-hp. motors driving bale breakers. The use of 550 volts for the mill and storehouse motors permits economical transmission from one power transformer bank, since only one 2300-volt power feeder is required at this voltage.

The weave-shed power transformers are arranged in five banks of 600 kva. each. For reliability, and to minimize the reactive drop which would have resulted from the use of one feeder for a load of this size, the transformer banks are energized from two separate power feeders. An additional feeder serves the lighting transformers for the mill and storehouse, the latter having a single-phase transformer connected with one of the 2300-volt legs, which is carried in conduit to an outdoor-type transformer mounted on the canopy over the shipping platform. The fifth 2300-volt feeder serves four banks of lighting transformers in the weave shed.

A hand-operated 2300-volt distributing switchboard equipped with remote-control apparatus is installed. Front and back alleys are provided for inspection of switches and removal of tanks. Three-section panels carry the apparatus, which includes a polyphase indicat-

FIG. 3—BALE BREAKERS DIVIDED INTO GROUPS OF THREE MACHINES EACH TO PERMIT FLEXIBLE OPERATION

ing wattmeter, an inverse-definite-time-limit relay, an oil circuit breaker and a polyphhase watt-hour meter.

At all except one of the five power transformer locations in the weave shed is a bank of lighting transformers. In each of these vaults an oil circuit breaker is provided for each transformer bank, the two breakers being mounted on a single-section panel carried on pipe frame and having double-coil series trips with oil dash-pot attachments. Series trips were chosen for these breakers to secure a cheaper trip than is afforded by relays with current transformers and to permit a suitable time element before opening the circuit on overload.

The 550-volt distributing boards in the mill each consist of a disconnecting and metering panel and the required number of single-circuit feeder panels. A hook-operated knife disconnecting switch for separating the bus from the power supply and a watt-hour meter

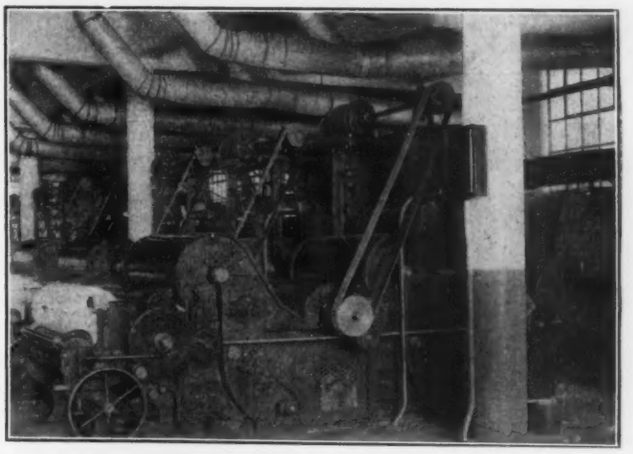


FIG. 4—PICKERS WITH INDIVIDUAL MOTORS MOUNTED ABOVE MACHINES

for measuring the total power to the floor constitute the first panel. Each feeder panel is equipped with a single-phase ammeter and a double series-trip oil circuit breaker having a dash-pot time-limit attachment. A voltmeter on the first-floor switchboard indicates the potential on the 550-volt system. The tripping attachment and time-element device used are simple and

effective, and eliminate the expense of current transformers and separate relays. Single-phase ammeters, which are used instead of indicating wattmeters to eliminate current transformers, indicate the load on each feeder and permit proportioning the total power among the different lines. All of the switchboards are of natural oil-finished Monson slate, which is satisfactory electrically for all voltages used and is not stained by oil from the breakers. All switchboards were furnished and installed by the Condit Electrical Manufacturing Company. All oil circuit breakers have electrically welded boiler-iron tanks and the switch frames are provided with heavy lips, which engage the tops of the tanks and prevent their blowing off when the switches open under heavy overloads.

### TRANSFORMER EQUIPMENT

The transformers for the mill and storehouse power supply are located outdoors beside the wire tower, and consist of four 1250-kva. self-cooled units, one of which is a spare. These transformers serve the bulk of the load in the plant, and as the entire power supply for the spinning mill is concentrated in this single bank, reliability is of prime importance. For this reason and to facilitate change-over when necessary, the fourth transformer was provided and the switching arrangement developed as shown in an accompanying diagram. The spare transformer is provided with a set of high and low-tension tie buses, permanently connected with double-throw switches, by means of which the spare transformer may be substituted for any of the regular units. The double-throw high-tension switch is provided so that the spare unit may be kept warm and in readiness for service. The value of this arrangement has already been demonstrated by the convenience afforded in taking the individual transformers out of service for drying and filtering the oil. With two transformers out of service, the larger part of the load can still be carried. Simultaneous failure of more than two transformers is very improbable.

The transformers are sheltered by a light concrete roof supported by a structural-steel framework which supports the high and low-tension wiring. On the front of the structure are wire gratings with openings which give access to the 600-volt switches. Since the rear of the house is toward the mill it is provided with a brick fire wall. Small iron doors permit access to the

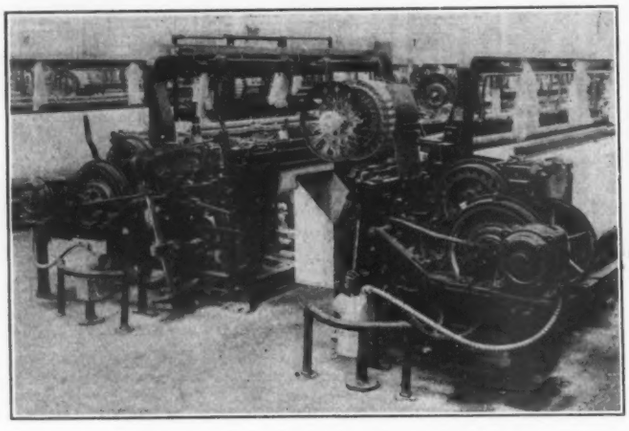


FIG. 5—METHOD OF APPLYING MOTOR DRIVE TO LOOMS

high-tension switches on this side. The transformers are mounted on steel rollers, rails being provided in the concrete floor to facilitate moving. The inclosure is pitched and drained to dispose of the oil in case of leakage.

The weave-shed power and lighting transformers are installed in vaults in the basement of the entrance towers. The mill lighting transformers are mounted in fireproof vaults in the basements. These vaults are ventilated and provided with raised door sills to prevent the escape of oil in accordance with insurance requirements. All of the lighting transformers for the plant, consisting of twenty-two units totaling 310 kva., were furnished by the General Electric Company, which also

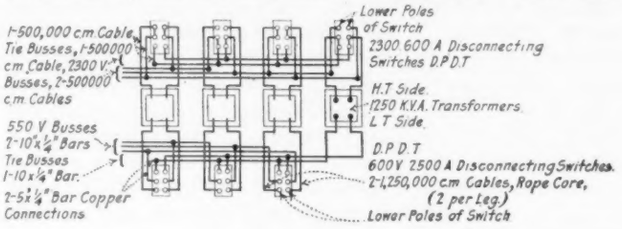



FIG. 6—SWITCHING ARRANGEMENTS USED IN CONNECTION WITH MILL AND STOREHOUSE TRANSFORMERS

furnished the weave-shed power transformers, consisting of five banks of three 200-kva. units.

### MILL POWER WIRING SYSTEM

Two 10-in. by 0.25-in. buses per leg were used from the main transformers into the wire tower, rather than a larger number of smaller bars, to secure rigidity where they run across the tops of the transformers. To prevent the entrance of birds, and of cold air in the winter, and yet give proper ventilation and insulation, the arrangement shown herewith was used. After entering the wire tower the power buses rise to the top of the building, tapering in size toward the end and being supported by insulators 4 ft. apart. Distributing boards are tapped off at the successive floors.

A 4000-amp. transformer circuit breaker was required in the main secondary circuit, but its price and lack of space made it necessary to devise special arrangements. With the approval of the insurance company two buses per leg were extended to the top of the wire tower, the theory being held that any current which might cause dangerous heating in buses of this size would trip the primary transformer circuit breaker.

All arguments appear to be in favor of the busbar rather than cable construction for this main riser. If all of the 550-volt distributing boards had been located on the first floor near the power entrance, cable would have been used for the individual outgoing feeders, but the necessity of having the switch control near the point of utilization of power made this construction impracticable. A system of multiple cables for the main power riser would have necessitated fuses at each end of each line to meet insurance requirements. These would have been very undesirable. The ease of supporting the buses and connecting the distributing boards is another advantage in favor of the bus construction employed. The busbar riser is run in a rectangular transite-board duct, except where the taps to the distributing boards are taken off.

To assure continuity of service and ease of control, to group the manufacturing processes efficiently and to avoid unnecessary reactive drop from heavy currents, current loads in individual feeders were limited to 200 to 300 amp., resulting in nineteen feeder panels for the mill. The power feeder circuits are protected by slow-burning insulation and are uninclosed. They are carried on cable racks into the mill and are back-braced at the boards. To improve the appearance in the mill, minimize the chance of mechanical injury and make the power wiring as inconspicuous as possible, the conductors are run through the beams instead of along the bottom of beams as is usually done.

All connections from feeders to starters and to motors are inclosed in rigid iron conduit throughout the plant

for safety, appearance and mechanical protection. In most locations the starters are mounted in pairs and a single tap is taken from the feeder to serve the pair. Frequent blowing of fuses at this point is avoided by making the tap not less than 30 per cent of the size of the feeder and connecting the two solidly.

In the mill and storehouse are 277 motors, having a total rating of 4150 hp. These units and the transformers serving them were furnished by the Westinghouse Electric & Manufacturing Company. Division of the bale breakers into two groups of three each gives sufficient flexibility to meet requirements. There is considerable variation in demand upon the three classes of machines included under pickers, but the individual motor drive permits the use of the proper number of machines at any time to meet the demands of service. For the cards, slubbers and drawing frames, however, group drives are satisfactory. The power requirement per machine is small; thus the cost per horsepower with individual motors would be very high. These machines are generally in continuous service so that the saving made possible by shutting down an individual machine is small.

The roving machines occupy three rows lengthwise of the mill. Two rows are operated by four-frame-drive motors and the third row by two-frame drives. Four rows of spinning frames also extend lengthwise of the mill. These, too, are operated by four-frame-drive motors. The two and four-frame drives were adopted for this type of machinery because the number of machines required to produce a certain output varies, and because a saving can be made by shutting down groups of machines when they are not needed. The energy consumption of these machines, particularly for spinning, is considerable, and group drives from very large motors would require heavy millwright work. Moreover, the variations in load, due to machines being in and out of service at different times, would cause speed variations in large motors which do not occur with the method of drive used. Since the power required by warpers, spoolers and twisters is rather small per machine, and since all these machines are in rather constant service, group drive is successfully used with them. To harmonize with the class of construction used in the plant, and to provide rigid and permanent mounting for the motors, structural steel supports were provided for all motors.

Low-voltage release attachments are provided on all motor starters in the mill and storehouse. If this provision were not made, and service were interrupted and quickly restored again, the simultaneous starting currents would trip the breakers on the 550-volt distributing boards and probably on the 2300-volt distributing board too. Before starting again every motor switch would have to be opened by hand, thus entailing a delay in closing the main feeder switches. Such an event would also establish a new peak on the purchased power supply which would probably require an added service charge thereafter. With the low-voltage release attachments, after an interruption to service, the motors may be started up in the regular manner.

All of the motors in the mill are provided with terminal boxes into which the conduit from the starting switch runs, giving a complete pipe connection from main feeder to motor. In these terminal boxes split connectors are provided for the motor leads. With this arrangement a motor may be quickly removed by removing the conduit lock nut on the terminal box and opening the connectors.

The looms, about 3000 in number, are driven by ½-hp. or ¾-hp. individual motors, depending on the size of the loom. These motors were furnished, together with the other motors in the weave shed, by the General Electric Company. These motors, which are of the low-torque continuously-running type, are started light by snap switches and the loom is started and stopped as required by a clutch. An individual motor to start the loom directly would have required a high-torque characteristic, adding to the expense and necessitating a compromise in the other characteristics of the motor to secure it. As the loom is normally in operation, it would be unwise to impair permanently the motor's running characteristics to meet a starting condition that does not frequently exist and when it does is only momentary. The slashers and the cloth-room machinery, which are in the weave shed, are driven by motors from 10 hp. to 25 hp. in size. Elevator motors and a 100-hp. motor on the humidifier compressor add 215 hp. to the load in this building.

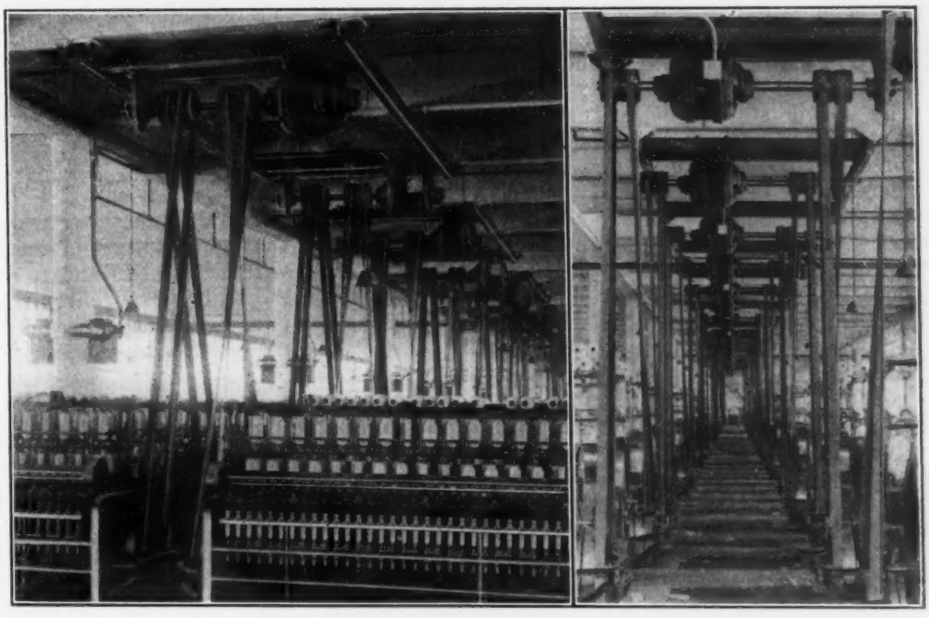


FIG. 7—TWO TYPES OF FOUR-FRAME DRIVE USED WITH SPINNING FRAMES

### STOREHOUSE AND MILL LIGHTING

Since the storehouse is used chiefly for the storage of cotton bales, illumination of low intensity is satisfactory, and is obtained by 40-watt lamps installed 32 ft. apart. As the story heights are determined by the space necessary for storing cotton bales on end, there is very little clearance, so the lamps are mounted in box receptacles, without reflectors, directly on the slab. All of the wiring is run in conduit concealed in the slab. Energy is provided by a 10-kva. transformer connected on one leg of the 2300-volt mill lighting feeder, which is extended in lead-covered cable carried in conduit to the weave shed.

Concealed conduit risers from the banks of lighting transformers serve flush cabinets on the various floors of the main mill. The wiring from cabinets is in conduit throughout. For the sections occupied by rovers,

intermediates and spinning frames the outlets are so numerous and the spacing so special that concealed conduit is used up to certain points and exposed conduits beyond. Thus if the type of machinery is changed a different system of exposed conduits can be arranged from these definite feeding points. The mill is five bays wide, and longitudinal lines of conduit are installed in three of the bays with outlets 24 ft. apart in the sections mentioned. Cut-outs inclosed by pressed-steel boxes are provided at these points to serve the single-phase tap circuits.

On account of the size of the load and the transmission involved, three-phase, 110-volt feeders are used in general from the cabinets with single-phase tap circuits connected as required, with cut-outs on the ceiling, and lamps controlled in large groups from the cabinets. Reflectors are of the Ivanhoe steel type with green enamel outside, white inside, and clamp strap holders. Reinforced "slicked" drop cord is used with brass-shell keyless sockets having porcelain strain relief in cap.

Distributing panels inclosed by steel cabinets and bearing fused knife switches are mounted on the walls of the five transformer vaults in the weave-shed basement. On account of the relatively low voltage employed, and the load, the currents involved are considerable. The switches and busbars in the distributing cabinets are consequently liberally proportioned and the cabinets are provided with diamond mesh doors to give ample ventilation.

The wiring system, depending on the location, load and other circumstances, consists of four 400,000-circ. mil feeder circuits with six branches of No. 4 B. & S. conductors feeding about thirty looms. Three No. 12 B. & S. wires connected permanently to the branches rise through conduits to the fused starting switches above the slab. The main feeders run north and south four bays in from the outside walls of the building, one section of the weave shed being sixteen bays wide and the other eight.

The fuses required for motor protection are mounted in condulet supported on pipe framework which also carries a three-pole snap switch with cast-iron protective housing for the control of the motor. Except at main alleys, etc., the branch lines under the floor serve two rows of looms for which a fitting with two snap switches and two sets of fuses is used.

In the weave shed the rows of looms run north and south and the saw-tooth roofs east and west. As the roof and supporting beams are of concrete and the space from floor to roof is entirely clear (tie rods not being used between the saw-tooth beams) a system of illumination without suspension wires of any sort between beams was desired. There are four rows of looms, and therefore two weavers' alleys per bay. Very satisfactory illumination was secured by arranging 150-watt lamps with extensive-type reflectors in the center of these alleys 13 ft. above the floors. The units are suspended by drop cords from box rosettes, served by conduit concealed in the beams. Three phase, 110-volt feeders carried in conduit in the basement are run out from the various lighting transformer banks to the center of the weave shed, and tap circuits in concealed conduit taken up through the columns to serve the lamps overhead.

The basis on which electric service is furnished to this plant was given quite completely in the Sept. 30, 1916, issue of the ELECTRICAL WORLD. The mill is expected to maintain a power factor of 80 per cent and to install synchronous apparatus to secure this condition if the power factor falls below 75 per cent. The normal power load is from 4000 to 4500 kw., to which the lighting loads adds 275 to 300 kw. The power factor remains about 82 per cent, with a rise during lighting periods.

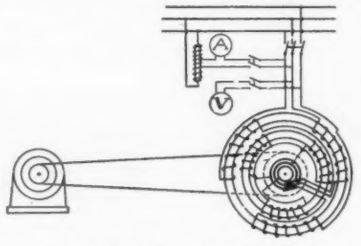
The system of electric drive used in this plant has resulted in an efficiency of production probably never before attained in a mechanically driven plant of its kind and has permitted an output very closely approximating the theoretical maximum for the machines employed. Lockwood, Greene & Company of Boston, Mass., handled the engineering for buildings and equipment, and supervised the construction of the plant.

---

## METHOD OF SYNCHRONIZING

### Proper Time to Parallel Alternators Indicated by Voltmeter or Ammeter Reading

A novel and effective method of synchronizing generators or motors in which both members of the machine are electrically connected to an alternating-current circuit is described in patent No. 1,204,169, issued to Carl A. Lohr of New York. The operation is as follows: The speed of the motor is raised to a value in the neighborhood of the synchronous speed. Then a fraction of the supply-voltage is impressed upon the motor windings with a voltmeter and an ammeter in circuit. The proper moment for synchronizing is indicated either by the ammeter showing a minimum current or by the voltmeter showing a maximum voltage.



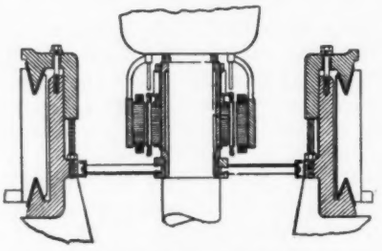

SYNCHRONIZING CIRCUITS

---

## COOLING VARIABLE-SPEED MOTORS

### Fan Operated by Auxiliary Motor Mounted Loosely on Machine Shaft

The irregular and changeable speeds at which variable-speed motors are operated are not conducive to normal self-cooling. In order to keep a motor cool under all conditions of operation, Henry V. Nye, Milwaukee, Wis., has devised a scheme which is the subject of patent No. 1,209,992. A rotary fan is mounted loosely on the motor shaft so that its speed of rotation will be independent of the shaft or rotor speed. Under ordinary high-speed operating conditions the rotor and fan rotate in common and ventilate the machine sufficiently. When the rotor speed drops the fan is rotated independently by an auxiliary motor attached to the fan but independent of the main motor speed. With this arrangement the main motor can be at a standstill and the fan rotated at any desired rate of speed.



AUXILIARY MOTOR MOUNTING

# Human Factor in the Hotel Cooking Load

## Stewards and Chefs Must Be Convinced of Advantages of Electricity, Generally by Trial Installations of Single Pieces of Electrical Equipment

BY FRANK B. RAE, JR.

PROBABLY no field for the industrial application of electric heat has been so misunderstood or had such tardy attention as the sale of electric cooking equipment and service to hotels, clubs and restaurants. This hotel load has suffered about equally, perhaps, from neglect and over-enthusiasm. Those who should have been interested in selling and installing this profitable class of apparatus either have done nothing or they have tried to do too much. And the result is that we have in this country hardly more than a bare hundred of hotel

ELECTRIC GRILL HELPS MAKE SAVORY MEALS AT THE BANKERS' CLUB, NEW YORK

cooking installations of any size, whereas there might be—should be—thousands.

It is difficult for any man unfamiliar with hotel cooking to realize the huge scale upon which the operations of a public victualer are performed. Therein lies the cause of our failure to grasp this opportunity. We cannot comprehend the problems nor appreciate the system involved in transforming five tons of cheese into welsh rabbits in thirty days.

### SOME FAIR-SIZED LONG-HOUR LOADS

We cannot grasp the electrical requirements of cooking a 15-gal. kettle of soup. We almost refuse to believe that a single rather small and exclusive hotel runs its 4400-watt broiler continuously, seven days each week, from 6.30 in the morning until 1 o'clock the next morning—a daily energy consumption of more than 80 kw.-hr.

When such staggering facts are presented, one of two things happens: either we fall victim to the get-rich-quick idea and try to electrify immediately and completely every hotel and restaurant in sight, or else we throw up our hands in despair.

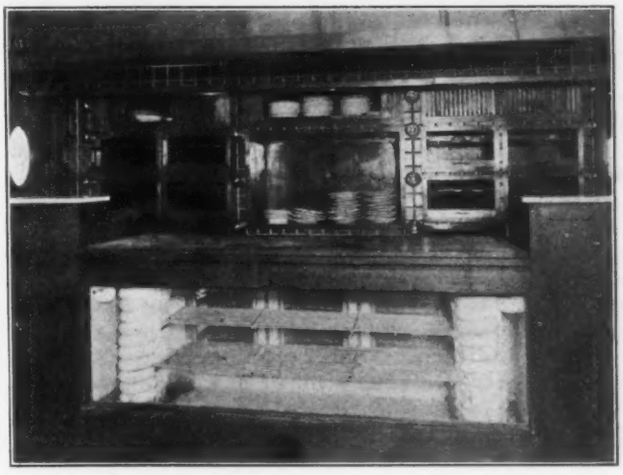
The first thing to realize, in attacking the problem of selling electric cooking apparatus to restaurants and hotels, is that it must be done piecemeal. No chef will permit his kitchen to be disrupted, his system to be demoralized. It has been truly said that the kitchen is the heart of the modern hotel, and that when it ceases to function the entire service collapses.

Understanding this basic fact, it must be plain that it is a serious mistake to try to change over the entire equipment at once. Such a change would be too revolutionary. It would inevitably result in confusion, disorganization and dissatisfaction. No matter how thoroughly a chef or steward might be "sold" on the electrical idea, it would be little less than suicidal for him to authorize a complete electrification at one time. Successful salesmen of hotel cooking equipment are content to make progress slowly. Some of the best installations in New York, for example, started with a single broiler—a few started with only a toaster. And most of them started with a free trial of from thirty days to six months.

At the outset it is necessary to get the chef's ideas about his particular and peculiar requirements. Most chefs are foreigners. They are temperamental as opera stars, finical as old maids. The chefs of big and famous hotels get salaries of more than $10,000 a year. Salesmen who approach men of such caliber with the thought that they are merely kitchen mechanics are doomed to disappointing experiences, for the chances are that the chef not only has the instincts of an artist, but the executive ability of a railroad superintendent, plus a very thorough, if unacademic, knowledge of chemistry, physics and mechanics. He is not a man to be *told* about electric cookery—he must be *consulted* as to whether, how and when electric service can be applied to his problems. Even the lesser chefs and cooks, the men who "brown the wheats" and manipulate the egg boiler, have a certain amount of the pride of craftsmanship in their work. Salesmen who aim to be successful in dealing with them must appreciate this viewpoint.

### AMPLE WATTAGE NECESSARY FOR "SPEED"

Almost the first thing we learn when discussing electrification seriously with a busy restaurant chef is that he wants speed. Speed in cooking means plenty of heat, and high heat is to be secured only by ample consump-



EDISON WELFARE RESTAURANT RANGE, FEEDING 300 PERSONS WITH CONNECTED LOAD OF 28.7 KW.

tion of electricity. Because we are all accustomed to household toasters of 600 watts consumption at most, it is a bit staggering to have a chef demand results which can only be secured with a unit consuming six or seven times that amount. Yet 4000 watts is the size of a toaster installed in a rather small hotel in New England. A 2500-watt unit was first tried; then a 3500-

watt unit; finally the big toaster was put in in sheer desperation—and gave satisfaction.

In speaking of this incident, Ben Crosby, who probably has sold more hotel equipment than any other man in the country, said: "The average salesman is afraid of his proposition. He is afraid to advocate units big enough to do the work for fear he'll lose the business. He is afraid to estimate energy costs high enough for the same reason. He too frequently sells inadequate equipment and he invariably underestimates the cost of operation. The result is that the light equipment doesn't stand up under the terrific strain of hotel cooking, and the purchaser is disappointed because of the size of his energy bills."

### Electric Broilers on Twenty Hours a Day

And right along this line let us mention the cost of operation. The electric kitchen of one New York hotel turns its broilers on in time for early breakfast service and does not turn them off again until the last midnight supper parties have gone. Careful manipulation would cut down the hours of burning fully one-half, but the chef does not want to cut the hours down; on the contrary, he removed the buttons from the snap switches so that the broilers could not be put out of commission except with a special tool. His reason is—speed. When he tosses a couple of *filets mignons* onto that grill he wants instant action. He does not want to wait three minutes for the broiler to come to heat. He cares nothing about the possible 75 cents a day which might be saved. He wants *speed*. Of what use to talk economy and kilowatt-hours to that man?

Economy of operation, as measured in kilowatt-hours, is comparatively unimportant. The real economy of electric cooking in hotels lies in the fact that there is no coal or charcoal to handle, no ash to remove, no fire to tend, no dirt, no smoke, no gas burners to repair or renew, no uncertainty as to the cooking results. As a matter of fact, the cost of maintenance on either coal or gas equipment in hotels is so much higher than the cost of maintenance of first-class and *ample* electric equipment that one needs never worry about the monthly bills for energy.

Note that we emphasize the word *ample*. Electric cooking equipment in hotels and restaurants must be big and sturdy, built for rough, grueling service. When an assistant chef picks up that 15-gal. kettle of soup and slams it down on a range, the range must not crumple. And be assured the equipment gets just that kind of treatment. The cooking utensils are big and heavy; the chefs bang, smash and slam them around without mercy.

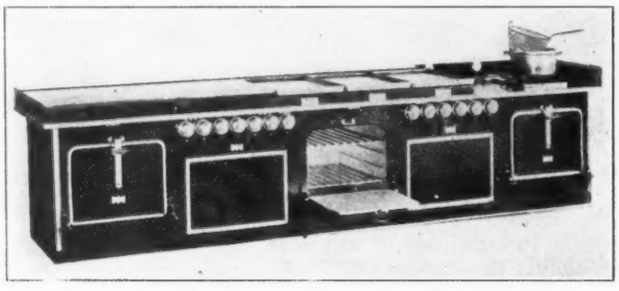
And the heat strains are equally severe. Restaurant apparatus requires fully double the amount of heat needed in a domestic appliance. The low and intermediate heats are seldom used. Everything is run at top speed. The heating units must be designed to stand any extreme of service. In this connection it is to be noted that the modern practice in electric and hotel equipment is to place these switches away from the heating units. No snap switch, no matter how good, will long stand up when located near a battery of hot plates or broiling grills. Knife switches, located upon a board away from the ranges, are now being recommended—and this plan was suggested by a chef.

Trial offers are necessary to convince hotel stewards and chefs of the advantages of electric kitchen equipment. Such trials, however, can be offered with confidence if the apparatus is right. One manufacturer of electric ranges for hotels claims never to have taken out a trial installation. In most cases a thirty-day trial will win the order, but in some cases the chef will insist upon a longer trial, so as to satisfy himself that the equipment will stand up in actual service.

The trial is best based upon a broiler. No central station or contractor should even try to get an order for an entire electric kitchen. It is a fatal mistake to start too big. In the first place the chef will not risk disorganizing his kitchen, and in the second place it takes a lot of salesmanship to secure the order for complete equipment from a man who has not had experience with electric apparatus; in the third place, it is prohibitive to put in a complete equipment on trial, and, finally, experience has proved that the best selling plan is to make the installation piecemeal.

An incident showing how hard it is to argue the average chef into believing in electric cooking occurred only a few days ago. A hotel manager was persuaded to put in a broiler on trial, but before he would even do this he insisted that a friend of his who is chef of a small hotel in the city where the apparatus is made should have a practical demonstration. This chef had been solicited without success, but agreed to watch the demonstration as a favor to his friend. On the appointed day he came to the factory with a couple of steaks, a chicken and some lamb chops.

He stated bluntly that he didn't believe in electricity, but that he had brought enough stuff along to give the apparatus a fair chance. He cooked just one steak. Pulling it out in eight minutes, he jabbed his thumb into the center of the rich, juicy, perfectly broiled meat, and his entire manner changed. "Why," he exclaimed, "this is wonderful—wonderful! What a fool



ONE OF THE ELECTRIC RANGES USED TO PREPARE MEALS FOR WELLESLEY COLLEGE GIRLS

I was not to come here before! I will tell our manager we must have one of these broilers in my kitchen. I will insist upon it. In the meantime you can ship this broiler to my friend in ———. I will write him—no, I will telegraph him—that this is the best broiler in the world."

### An Exclusive Electric Kitchen

Another incident: One of the largest hotels in the world, now building, will have an exclusively electric kitchen, the cost of the equipment running into thousands of dollars. That sale was made upon the results of a trial installation of a broiler. The owner of the new hotel is at present operating a hostelry in New York, where he was persuaded to give electricity a trial. From a single broiler his electric equipment in the old hotel has grown piecemeal. When the plans for the new and larger hotel were drawn, he specified that everything should be electric.

That is the way to sell hotel and restaurant electric cooking equipment—piecemeal, and by demonstration and trial. The market is big. The margin of profit on the apparatus is ample. Every unit sold means an installation job for the electrical contractor. The kilowatt-hour consumption is large and the load factor desirable. And every installation is an advertisement both of electric service and electric cooking, which means that the business will grow and that it will favorably influence the sale of electric household ranges.

# Insulation of High-Voltage Transformers—II

## Second of Two Articles Taking Up the Fundamental Principles Underlying All Problems of Insulation and Giving Data Which Will Enable the Determination of Insulation Dimensions for Different Services

BY ALFRED STILL
Professor of Electrical Design, Purdue University

SOME of the fundamental principles governing calculations for dielectric circuits were given in the first part of this article, which appeared in the Feb. 17 issue of the ELECTRICAL WORLD. The effect of employing together dielectrics with different inductive capacities was also discussed. Part II, which follows and concludes the article, deals with subjects connected with the more practical side of insulating high-tension apparatus.

### PRACTICAL RULES APPLICABLE TO THE INSULATION OF HIGH-VOLTAGE WINDINGS

For working pressures up to 16,000 volts solid insulation, including cotton tape, micanite, pressboard, horn paper, or any insulation of good quality used to separate the windings from the core or framework, should have a total thickness of approximately the following values:

| Voltage | Thickness of Insulation (mils) | Voltage | Thickness of Insulation (mils) |
|---|---|---|---|
| 110 | 40 | 6,600 | 180 |
| 400 | 45 | 12,000 | 270 |
| 1,000 | 65 | 16,000 | 350 |
| 2,200 | 90 | | |

In large high-voltage power transformers, cooled by air blast, the air spaces are relied upon for insulation. The clearances between coils and core or case are necessarily much larger than in oil-cooled transformers, and calculations similar to the example previously worked out should be made to determine whether or not the insulation is sufficient and suitably proportioned to prevent brush discharge. The calculations are made on the basis of several plate condensers in series; thus the flux density and dielectric stress in the various layers of insulation can be approximately predetermined. The difficulty of avoiding static discharges will generally stand in the way of designing economical air-cooled transformers for pressures much above 30,000 volts. A rough rule for air clearance is to allow a distance equal to $\frac{1}{4} + \frac{E}{4000}$ inches, where E stands for the virtual value of the alternating potential difference in volts between the two surfaces considered.

With oil-immersed transformers, the oil channels should be at least 0.25 in. wide in order that there may be free circulation of the oil. In high-voltage transformers having a considerable thickness of insulation between coils and core, it is advantageous to divide the oil spaces by partitions of pressboard or similar material. Assuming the total thickness of oil to be no greater than that of the solid insulation, a safe rule is to allow 1 mil for every 25 volts. For instance, a total thickness of insulation of 1 in. made up of 0.5 in. of solid insulation and two 0.25 in. oil ducts would be suitable for a working pressure not exceeding $25 \times 1000 = 25{,}000$ volts. Further particulars relating to oil insulation will be given later.

It is customary to limit the volts per coil to 5000, and the volts between layers of winding to 400. Special attention must be paid to the insulation under the finishing ends of the layers by providing extra insulation ranging from thin paper to Empire cloth or even thin fullerboard, the material depending upon voltage and also upon the amount of mechanical protection required to prevent cutting through the insulation where the wires cross. Sometimes the insulation is bent around the end wires of a layer to prevent breakdown over the ends of the coil. Where space permits, however, the layers of insulation may be carried beyond the ends of the winding so as to avoid surface leakage. This arrangement is more easily carried out in core-type transformers than in shell-type units. A practical rule for determining the surface distance (in inches) required to prevent leakage (given by Messrs. Fleming and Johnson in the book previously referred to) is to allow 0.5 in. + 0.5 × kilovolts, when the surfaces are in air. For surfaces under oil, the allowance may be 0.5 + (0.1 kilovolt). In any case it is important to see that the creepage surfaces are protected as far as possible from deposits of dirt. When the coils of shell-type transformer are "sandwiched," it is customary to use half the normal number of turns in the low-tension coils at each end of the stack. This has the advantage of keeping the high-tension coils well away from the iron stampings and clamping plates or frame.

### EXTRA INSULATION ON END TURNS

Concentration of potential between turns at the ends of the high-tension winding is liable to occur with any sudden change of voltage across the transformer terminals, such as when the supply is switched on, or when lightning causes potential disturbances on the transmission lines. It is therefore customary to pay special attention to the insulation of the end turns of the high-tension winding. Transformers for use on high-voltage circuits usually have about 75 ft. at each end of the high-tension winding insulated to withstand three to four times the voltage between lines that would puncture the insulation in the body of the winding.

It is very difficult to predetermine the extra pressure to which the end turns of a power transformer connected to an overhead transmission line may at times be subjected, but it is safe to say that the instantaneous potential difference between turns may occasionally be of the order of forty to fifty times the normal working pressure. In such cases the usual strengthening of the insulation on the end turns would not afford adequate protection, so a separate specially designed reactance coil connected to each end of the high-tension winding would seem to be the best means of guarding against the effects of surges or sudden changes of pressure occurring in the electric circuit outside the transformer. The theory of abnormal pressure rises in the end sections of transformer windings will not be discussed here.

### WINDING SPACE FACTOR

Knowing the thickness of the cotton covering on the wires, the insulation between layers of winding, between coil and coil and between coil and iron stampings, it becomes an easy matter to determine approximately the total cross-section of the winding-space to accommodate a given cross-section of copper. The ratio $\frac{\text{cross-section of copper}}{\text{cross-section of winding space}}$, which is known as the space factor, will naturally decrease with the higher voltages and smaller sizes of wire. This factor may be as high as 0.45 in large transformers for pressures not

exceeding 2200 volts; in 33,000-volt transformers for outputs of 200-kva. and upward it will have a value ranging between 0.35 and 0.2, while in oil-immersed power transformers for use on 100,000-volt circuits the factor may be as low as 0.13.

### Oil Insulation

There is a considerable amount of published matter relating to the properties of insulating oils, and also to the various methods of testing, purifying, and drying oils for use in transformers. A concise statement of the points interesting to those installing or having charge of transformers will be found in W. T. Taylor's book on transformers.* What follows here is merely intended as a guide to the designer in providing the necessary clearances to avoid spark-over, including a reasonable factor of safety.

Mineral oil is generally employed for insulating purposes, its main function in transformers being to transfer the heat by convection from the hot surfaces to the outside walls of the containing case, or to the cooling coils when these are provided. The presence of an extremely small percentage of water reduces the insulating properties of oil considerably. It is therefore important to test transformer oil before using it, and if necessary extract the moisture by filtering through dry blotting paper, or by any other approved method. Dry oil will withstand pressures up to 50,000 volts (alternating) between brass disks 0.5 in. in diameter with a separation of 0.2 in. For use in high-voltage transformers, the oil should be required to withstand a test of 45,000 volts under the above conditions. The good insulating qualities of oil suggest that only small clearances would be required in transformers even for high voltages, but the form of the surfaces separated by the layer of oil will have a considerable effect upon the concentration of flux density, and therefore upon the voltage gradient. As an example, if 100,000 volts breaks down a 1-in. layer of a certain oil between two parallel disks 4 in. in diameter, the same pressure will spark across a distance of about 3.5 in. between a disk and a needle point.

Partitions of solid insulation such as pressboard or fullerboard are always advisable in the spaces occupied by the oil, since they will prevent the lining up of partly conducting impurities along the lines of force and thereby reduce the total clearance which would otherwise be necessary.

In a transformer oil of average quality the sparking distance between a needle point and a flat plate is approximately $(0.25 + 0.04 \times \text{kv.})$ inches. Since there may be sharp corners or irregularities corresponding to a needle point, which will produce concentration of dielectric flux, it therefore seems advisable to introduce a factor of safety for oil spaces between high tension and grounded metal—for instance, at the ends of high-tension coils and the containing case—by basing the oil space dimension on the formula,

$$\text{Thickness of oil (inches)} = 0.25 + 0.08 \text{ kv.} \quad (7)$$

With two or three partitions of solid insulating material dividing the oil space into sections, the total thickness need not exceed

$$0.25 + 0.05 \text{ kv.} \quad (8)$$

If the total thickness of solid insulation is about equal to that of the oil ducts (not an unusual arrangement between coils and core), the rule previously given for solid insulation may be slightly modified to include a minimum thickness of 0.25 in., and put in the form,

$$\left.\begin{array}{l}\text{Total thickness of oil ducts plus solid insulation of approximately equal thickness (inches)} \ldots\ldots\ldots\end{array}\right\} = 0.25 + 0.03 \text{ kv.} \quad (9)$$

A suitable allowance for surface leakage under oil, as already given, is,

$$0.5 + (0.1 \text{ kv.}) \text{ inches} \quad (10)$$

### Terminals and Bushings

The exact pressure which will cause the breakdown of a transformer terminal bushing generally has to be determined by test, because the shape and proportions of the metal parts are rarely such that a concentration of flux density at corners or edges can be accurately predetermined. However, there are certain important points to bear in mind when designing the insulation of transformer terminals, and these will now be referred to briefly.

The high-tension leads of a transformer may break down (1) by puncture of the insulation, or (2) by spark-over from terminal to case. If the transformer lead could be considered as an insulated cable with a suitable dielectric separating it from an outer concentric metal tube of considerable length, the calculation of the puncture voltage (1) would be a simple matter. For instance, let $r$ in Fig. 6 be the radius of the inner (cylindrical) conductor, and $R$ the internal radius of the inclosing tube, the space between being filled with a dielectric of which the specific inductive capacity $(k)$ is constant throughout the insulating material. The equipotential surfaces will be cylinders, and the flux density over the surface of any cylinder of radius $x$ and of definite length, say 1 cm., will be $D = \frac{\psi}{2\pi x}$.

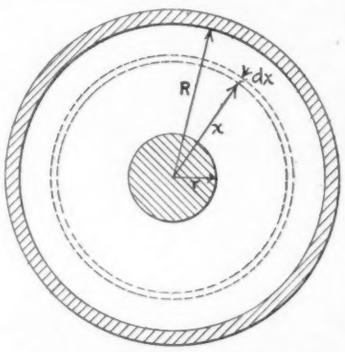



FIG. 6—CONDUCTOR SEPARATED FROM INCLOSING METALLIC SURFACE BY DIELECTRIC

By formula (6) the potential gradient is,

$$G = \frac{D}{Kk} = \frac{\psi}{2\pi x K k} \quad (11)$$

In order to express this relation in terms of the total voltage $E$, it is necessary to substitute for the symbol $\psi$ its equivalent $E \times C$, and calculate the capacity $C$ of the condenser formed by the rod and the concentric tube. Considering a number of concentric shells in series, the elastance may be written as follows:

$$\frac{1}{C} = \int_r^R \frac{dx}{2\pi x K k} = \frac{1}{2\pi K k} \log_e \frac{R}{r} \quad (12)$$

Substituting in (11), we have,

$$G = \frac{E}{x \log_e \frac{R}{r}} \text{ volts per centimeter} \quad (13)$$

the maximum value of which is at the surface of the inner conductor, where

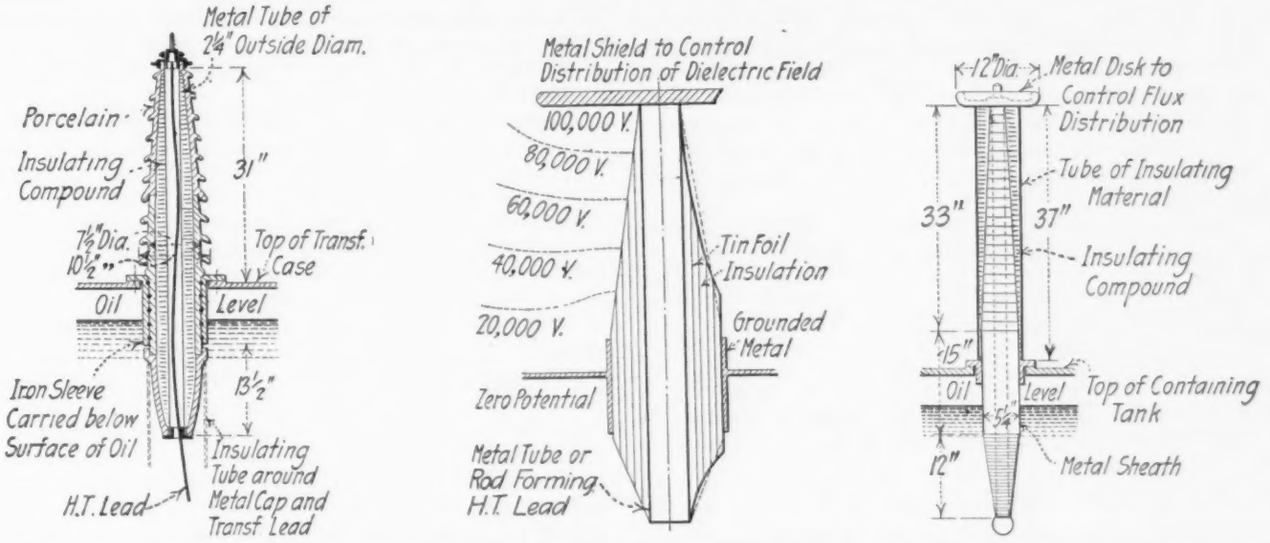
$$G_{max} = \frac{E}{r \log_e \frac{R}{r}} \quad (14)$$

This formula is of some value in determining the thickness of insulation necessary to avoid overstressing the dielectric; but it is not strictly applicable to transformer bushings in which the outer metal surface (the bushing in the lid of the containing tank) is short as

*"Transformer Practice," by W. T. Taylor: McGraw-Hill Book Company, Inc. For further information refer H. W. Tobey on the "Dielectric Strength of Oil"—*Trans.* A.I.E.E.; Vol. XXIX, page 1189 (1910). Also "Insulating Oils," Journ. Inst. E.E., Vol. 54, page 497 (1916).

compared with the diameter of the opening. The advantage of having a fairly large value for $r$ is indicated by formula (14), and a good arrangement is to use a hollow tube for the high-tension terminal, with the lead from the windings passing up through it to a clamping terminal at the top.

Solid porcelain bushings with either smooth or corrugated surfaces may be used for any pressure up to 40,000 volts, but for higher pressures the oil-filled type or the "condenser" type terminal is preferable. In designing plain porcelain bushings it is important to see that the potential gradient in the air space between the metal rod and the insulator is not liable to cause brush discharge, as this would lead to chemical action, and a green deposit of copper nitrate upon the rod. The calculations would be made as explained for the parallel-




FIGS. 7, 8 AND 9—OIL-FILLED AND CONDENSER-TYPE BUSHINGS, WITH EQUIPOTENTIAL SURFACES OBTAINED WITH THE LATTER

plate condensers in which a sheet of glass was inserted (see "Capacities in Series"), except that the elastances of the condensers are now expressed by formula (12).

### OIL-FILLED BUSHINGS

The chief advantages of a hollow insulating shell filled with oil or insulating compound that can be poured in the liquid state are the absence of air spaces where corona may occur, and the possibility of obtaining a more uniform and reliable insulation than with solid insulators—such as porcelain, when the thickness is considerable. The metal ring by which such insulator (see Fig. 7) is secured to the transformer cover usually takes the form of a cylinder of sufficient length to end below the surface of the oil. The advantage of this arrangement is that the dielectric flux over the surface of the lower part of the insulator is through oil only, and not, as would otherwise be the case, through oil and air. With the two materials of different dielectric constants, the stress at the surface of the oil may exceed the dielectric strength of air, in which case there would be corona or brush discharge which might practically short-circuit the air path and increase the stress over that portion of the surface which is under the oil.

The bushing illustrated in Fig. 7 has been designed for a working pressure of 88,000 volts between high-tension terminal and case, the method of computation being, briefly, as follows: Applying the rule for surface leakage distances previously given, this dimension is found to be $0.5 + 88/2 = 44.5$ in. The insulator need not, however, measure 44.5 in. in height above the cover of the transformer case, because corrugations can be used to obtain the required length. A safe rule to follow in deciding upon a minimum height, *i.e.*, the direct distance in air between the terminal and the grounded metal, is to make this dimension at least as great as the distance between needle points that would just withstand the test voltage without sparking over. The test pressure is usually twice the working pressure plus 1000 volts, or 177 kv. (r.m.s. value) in this particular case. This value corresponds to a distance of about 48 cm., or (say) 19 in. In order that there may be an ample margin of safety, it will be advisable to make the total height of the insulator not less than 22 in., apart from the number or depth of the corrugations. The actual height in Fig. 7 is 31 in. because the corrugations on the outside of the porcelain shell are neither very numerous nor very deep. In this connection it may be stated that a short insulator with deep corrugations designed to provide ample surface distance is not usually so effective as a tall insulator with either a smooth surface or shallow corrugations. The reason is that much of the dielectric flux from the high-tension terminal to the external sleeve or supporting framework passes through the flanges, the specific inductive capacity of which is two to three times that of the air between them. The result is an increased stress in the air spaces, which is equivalent to a reduction in the effective height of the insulator.

In the design under consideration it is assumed that the hollow (porcelain) shell is filled with an insulating compound which is solid at normal temperatures, and that the joints therefore need not be so carefully made as when oil is used. The insulator consists of three parts only, which are jointed as indicated on the sketch. Oil-filled bushings for indoor use generally have a large number of parts, usually in the form of flanged rings with molded tongue-and-groove joints filled with a suitable cement. With this construction, however, there is always the danger that a vessel may not be quite oil-tight, therefore the solid compound has an advantage over the oil in this respect.*

The creepage distance over the surface of the insulator in oil may be very much less than in air. Applying the rule previously given, the minimum distance in this case would be $0.5 + (0.1 \times 88) = 9.3$ in. In the design illustrated by Fig. 7, however, this dimension has been increased about 50 per cent with a view to keeping the high-tension connections well away from the surface of the oil and grounded metal. To prevent the accumulation of conducting particles in the oil along the

*A description of the oil-filled type of transformer bushing, as made by the General Electric Company, will be found in the *General Electric Review* of June, 1913 (Vol. XVI, page 404).

lines of stress, and afford increased protection with only a small addition in cost, it is advisable to slip one or more insulating tubes over the lower part of the terminal, as indicated by the dotted lines in the sketch. Corrugations on the surface of the insulator in the oil are usually unnecessary, and sometimes objectionable because they collect dirt which may reduce the effective creepage distance.

Having decided upon the height and surface distances to avoid all danger of spark-over, the problem remaining to be dealt with is the provision of a proper thickness of insulation to prevent puncture. In order to avoid complication of the problem by considering the different dielectric constants ($k$) of the compound used for filling and of the external shell (assumed in this case to be porcelain), it may be assumed either that there is no difference in the dielectric constants of the two materials, or that the thickness of the inclosing shell of porcelain is negligibly small in relation to the total external diameter of the insulator. Either assumption, neglecting the error due to the limited length of the external metal sleeve,* permits the use of formula (14) giving the relation between the maximum potential gradient and the dimensions of the bushing without correction.

Suppose that the disruptive gradient of the insulating compound is 90 kv. per centimeter (maximum value) or 63.5 kv. per centimeter (r.m.s. value) of the alternating voltage. With a test pressure of 177 kv. and a margin of safety of 25 per cent the value of $E$ in equation (14) will therefore be $E = 177 \times 1.25 \times \sqrt{2} = 313$ kv.

Since the disadvantage of a very small value of $r$ is evident from an inspection of the formula, the outside diameter of the inner tube is made 2.25 in. Then, since

$$G = \frac{E}{r \log_e \frac{R}{r}}$$

$$\log_{10} \frac{R}{r} \qquad \frac{313}{2.54 \times 1.125 \times 90 \times 2.303} = 1.216$$

whence $R = 3.79$, or (say) 3.75 in. An external diameter of 7.5 in. at the center of the insulator will therefore be sufficient to prevent the stress at any point exceeding the rupturing value even under the test pressure.

### Condenser Type of Bushing

If the total thickness of the insulation between the high-tension rod and the (grounded) supporting sleeve is divided into a number of concentric layers by metallic cylinders, the concentration of dielectric flux at certain points (leading to high values of the voltage gradient) is avoided. The problem is therefore resolved into the simple case of a number of plate condensers in series, with a definite potential difference between the plates. Supposing the total radial depth of insulation is divided into a large number of concentric layers, (of the same thickness), separated by cylinders of tinfoil (of the same area), conditions would be equivalent to several condensers of equal capacity in series across the full potential difference. The dielectric flux density, and therefore the potential gradient, would be the same in all the condensers, so that the outer layers of insulation would be stressed to the same extent as the inner layers, and the total radial depth of insulation would be less than when the stress distribution follows the logarithmic law (formula 14) as in the case of the solid porcelain, or oil-filled, bushing.

The section on the right-hand side of Fig. 8 is a diagrammatic representation of a condenser bushing properly shaped to comply with the conditions of equal thicknesses of insulation and equal areas of the condenser plates. With a sufficient number of concentric layers, the ideal condition of equal potential difference between plate and plate throughout the entire thickness would be approximated; but the creepage distance over the insulation between the edges of the metal cylinders would be much smaller for the outer layers than for layers nearer to the central rod or tube. It is equally if not more important to prevent excessive stress over the surface than in the body of the insulator, so the practical condenser type of terminal is designed to compromise between the two conflicting requirements. By making the terminal conical in form, as indicated by the dotted lines on the right-hand side and the full lines on the left-hand side of the sketch (Fig. 8), neither of the ideal conditions is exactly fulfilled, but practical terminals so constructed are easily manufactured, and give satisfaction on circuits up to 150,000 volts.

If the ends of the metal cylinders coincide with equipotential surfaces having the same potential as that which they themselves attain by virtue of the respective capacities of the condensers in series, there will be no corona or brush discharge at the edges of these cylinders. This ideal condition is represented diagrammatically in Fig. 8, where a large metal disk is shown at the top of the terminal. The object of this metal shield is to distribute the field between the terminal and the transformer cover in such a manner as to satisfy the above-mentioned condition. In practice, the tendency for corona to form at the exposed ends of the tinfoil cylinders is counteracted by treating the finished terminal with several coats of varnish. In addition it is inclosed with an insulating cylinder filled with an insulating compound which can be poured in the liquid form and which solidifies at ordinary temperatures. This construction is shown in Fig. 9, which represents a practical terminal of the condenser type. Compared with Fig. 7, it is longer, but appreciably smaller in diameter where it passes through the transformer cover.

The dimensions of a condenser-type terminal such as illustrated in Fig. 9 may be determined approximately as follows: Assuming the working pressure as 88,000 volts, and the maximum permissible potential gradient in the dielectric (usually consisting of tightly wound layers of specially treated paper) as 90 kv.,* the maximum radial thickness of insulation required will be

$$\frac{\text{total volts}}{\text{voltage gradient}} = \frac{313}{90} = 3.48 \text{ cm. or (say) } 1.5 \text{ in.}$$

to include an ample allowance for the dividing layers of metal foil. If the inner tube is 2.25 in. in diameter, as in the previous example, the external diameter over the insulation at the center will be $2.25 + 3 = 5.25$ in. instead of the 7.5 in. required for the previous design.

It is customary to allow about 4000 volts per layer, and twenty-two layers of insulation alternating with twenty-two layers of tinfoil are used in this particular design. It is true that ideal conditions will not be actually fulfilled; the aggregate thickness of insulation might have to be slightly greater than 1.5 in., the inner tube might be made 1.75 in. or 2 in. instead of 2.25 in., and a practical terminal for 88,000-volt service could undoubtedly be constructed with a diameter over the insulation not exceeding 5.25 in.

The projection of the terminal above the grounded plate (the cover of the transformer case) need not be so great as would be indicated by the application of the practical rule previously given for surface leakage distance, namely, that this distance should be $(0.5 + \text{kv.}/2)$

*The maximum stress in the dielectric might be 5 to 10 per cent greater than calculated by using formulas relating to very long cylinders. The corners at the ends of the outer cylinder should be rounded off to avoid concentration of dielectric flux at these places.

*Same as in the example of the compound-filled insulator.

in., where kv. stands for the working pressure. The reason why a somewhat shorter distance is permissible is that the surface of the terminal proper has been covered by varnish and a solid compound, and so far as the inclosing cylinder is concerned, the stress along the surface of this cylinder will be fairly uniform, especially if a large flux-control shield is provided, as shown in Fig. 9. If the length of the external cylinder, in inches, is made equal to working kilovolts ÷ 2.3, it is probable that a voltage somewhat higher than the test pressure may cause a spark-over from metal to metal without damaging the insulation. In order to avoid the formation of corona at the lower terminal (below the surface of the oil) this end may conveniently be in the form of a sphere, the diameter of which would depend upon the voltage and the proximity of grounded metal.

# Advantages of Rock Island for Government Nitrate Plant

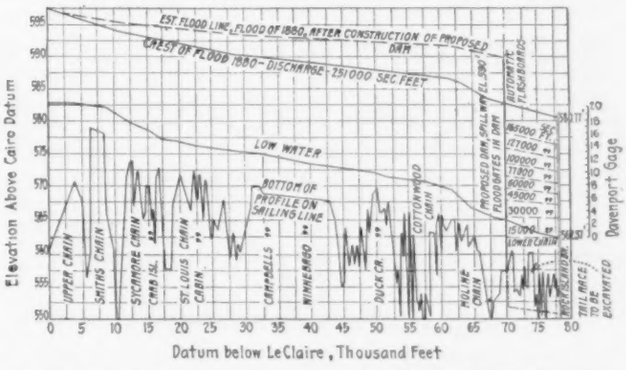
## Available Water Power, Nearness of Fuel for Auxiliary Steam Plant, Central Location, Transportation Facilities, Abundance of Labor and Protected Position Form Reasons for Selecting This Site

BY H. S. PUTNAM,
Consulting Engineer, New York City.

REASONS why the proposed government nitrate plant should be established at Rock Island, Ill., are presented in this article. In addition, estimated data are given on the approximate cost of developing different-size hydroelectric installations at this point. Among the advantages of Rock Island as a government center for producing nitrates are the following: First, about 100,000 kw. to 125,000 kw. in water power is available from the Mississippi River at Rock Island. Second, the Illinois coal fields are near, so that ample fuel for operating a reserve steam plant can be obtained and transportation eliminated by establishing the steam plant at the mine. Third, the site is centrally located with regard to the neighboring industrial centers as well as the rest of the country. Fourth, excellent transportation facilities are afforded by rail and water in all directions. Fifth, added electrical generating facilities are required at the Rock Island Arsenal that would be unnecessary if a generating plant were built for nitrate production. Sixth, abundant labor is obtainable in the vicinity. Seventh, the site, being far inland, is practically safe from foreign attack. In addition the Rock Island Arsenal is one of the finest and largest arsenals belonging to the United States government.

The arsenal is built on an island in the Mississippi at the foot of the Rock Island Rapids. The water power at this point is now used by the United States government and is only partly developed. Under present conditions the most economical development which could be made—*i. e.*, one which would produce power at the lowest cost per kilowatt-hour and per horsepower-year—is approximately 100,000 kw. The cost of the hydraulic works in the river will not be excessive, and the amount of power developed can be increased from a beginning of 30,000 kw. to 100,000 kw. or more as the demand for such power increases.

The general plan proposed is to develop the large amount of water power now available in the Mississippi River at Rock Island and insure a continuous supply of power by the construction of an auxiliary steam plant at the mines in the coal fields of Illinois. In connection with the auxiliary steam-power plant it is proposed to construct a plant for the recovery of the fixed nitrogen and other by-products that exist in the coal and for the production of fuel gas to be used under the boilers in the auxiliary steam-power plant. Supplemented by the steam-power plant the hydroelectric plant will furnish an almost unlimited amount of power at low cost for the recovery of nitrogen from the atmosphere by any process which the government may select. It is proposed to construct a dam above the railroad bridge between Davenport and the island of Rock Island, with a crest elevation of 21.63 ft. above low water. This elevation can be increased to 27.63 ft. by the use of automatic steel flash-boards, which lower automatically to allow floods to pass. In addition to the automatic flash-boards, discharge gates can be placed in the dam to relieve flood conditions. Careful consideration should be given, however, to a plan proposed under which the dam would be constructed opposite Moline, Ill., and the channel behind the island of Rock Island used as a tailrace, since such an arrangement would



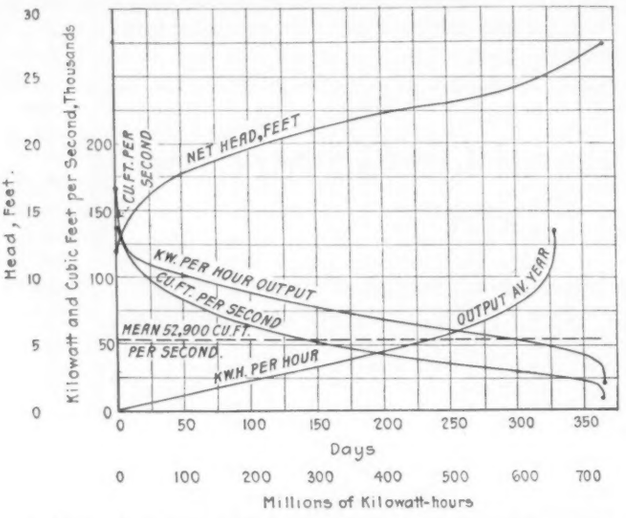

PROFILE OF MISSISSIPPI RIVER, LE CLAIRE TO DAVENPORT

reduce the property damage and the amount of protecting walls required. At the same time better relief would be afforded at flood times and the effective head would be increased.

Tabulated herewith is the estimated cost of constructing the proposed plant, the figures presented being based upon the high cost of materials and apparatus brought about by conditions produced by the war in Europe. It is assumed that money is worth 3 per cent to the United States government. Depreciation charges are based upon the economical life of the apparatus employed. The cost of coal has been taken as $1 per ton at the mine. This price can be realized or even reduced, it is believed, since low-grade and waste coal can be utilized. Data are also given on the cost of operating two hydroelectric developments of different size.

From the data showing the annual cost of operation for a 100,000-kw. hydroelectric installation it can be readily seen that using a by-product gas-producer plant

in connection with an auxiliary steam plant has marked advantages. In this case both the water-power plant and the steam plant are run continuously. The average load is thus increased from 100,000 kw. to 173,000 kw. Under these conditions the load will be 200,000 kw. for a period of about two months and will gradually fall off




AVERAGE YEARLY DURATION CURVE OF FLOW OF MISSISSIPPI RIVER AT DAVENPORT, IOWA

to approximately 130,000 kw. for a period of a few days. In a plant of this size, operated at its full capacity, developing an average of 173,000 kw. throughout the year, energy can be produced at an estimated cost of $2.90 per kilowatt-hour, or $2.16 per kilowatt-hour after due credit is made for the sale of by-products.

TABLE I—COST OF DEVELOPING AND OPERATING 100,000-KW. WATER-POWER PLANT

| | |
|---|---|
| Hydroelectric plant, complete (100,000 kw.) | $9,726,760 |
| Auxiliary steam plant in coal fields (100,000 kw.) | 5,527,420 |
| Transmission line, 60 miles with reserve line | 908,470 |
| Total | $16,162,650 |
| Gas-producer plant (1,350,000 tons) | 3,315,700 |
| Total estimated cost* | $19,478,350 |

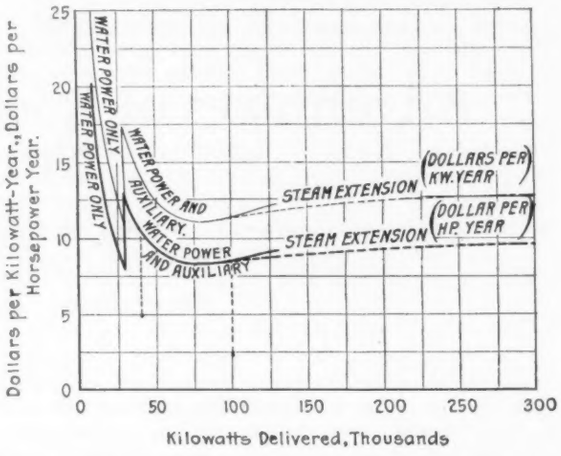
Annual Operating Costs

| | Total Annual Costs, Including Interest, Depreciation, Maintenance, Operation, etc. Average Load (Kw.) | | |
|---|---|---|---|
| | 100,000 W. P. & S. Aux. | 173,000 W. P. & S. Aux. | 173,000 W. P., S. Aux. and Gas Producer |
| Hydroelectric plant | $448,470 | $448,470 | $448,470 |
| Auxiliary steam plant, excluding coal | 410,560 | 621,840 | 621,840 |
| Transmission line (60 miles) | 50,900 | 50,900 | 50,900 |
| Gas-producer plant, excluding coal | ..... | ..... | 1,246,190 |
| Coal at $1 per ton | 224,180 | 793,380 | 1,348,750 |
| Total | $1,134,110 | $1,914,590 | $3,716,150 |
| Credits: | | | |
| Ammonium sul. at $60 ton | ..... | ..... | $3,034,800 |
| Tar at $4 per ton | ..... | ..... | 180,000 |
| | | | $3,214,800 |
| Net cost of power | $1,134,110 | $1,914,590 | $501,350 |
| Cost per kw.-year | $11.34 | $11.07 | $2.90 |
| Cost per hp.-year | 8.46 | 8.26 | 2.16 |

*The expenditure of $2,000,000 for river improvements, etc., now authorized, will be unnecessary and should be credited to the cost of this development.

An initial installation of 40,000-kw. in water-power equipment with an auxiliary steam plant of corresponding size and a gas producer plant can be constructed at an estimated cost of $11,663,090. The expenditure of $2,000,000 otherwise necessary for added facilities at the arsenal should be credited to this amount. In a plant of this size, operated at its full capacity, developing an average of 80,000 kw. throughout the year, energy can be produced at an estimated cost of $6.54 per kilowatt-hour, or $4.88 per horsepower-hour after due credit is made for the sale of by-products.

To meet existing conditions the following construction program is suggested: Construct the first portion of the auxiliary steam plant in the coal fields at once




COST PER HORSE-POWER-YEAR AT 100 PER CENT LOAD FACTOR AND RESULTANT NET COST TO NITRATE PLANT

and install therein generating equipment rated at 25,000 kw. to 50,000 kw. The initial plant should be designed for ultimate extension to two or three hundred thousand kilowatts or more. In selecting the size of units to be installed the ultimate development should be carefully considered. A high-tension transmission line should be constructed at once to connect the power plant with a substation to be constructed at the Rock Island Arsenal. This plant will take care of all the power developed at the present water power, amounting to 6000 kw. or 8000

TABLE II—COST OF DEVELOPING AND OPERATING 40,000-KW. WATER-POWER PLANT

| | |
|---|---|
| Hydroelectric plant, complete (40,000 kw.) | $8,208,580 |
| Auxiliary steam plant in coal fields (40,000 kw.) | 2,737,000 |
| Transmission line, 60 miles with reserve line | 717,510 |
| | $11,663,090 |
| By-product gas-producer plant (551,400 tons) | 1,560,380 |
| Total estimated cost* | $13,223,470 |

| | Total Annual Costs, Including Interest, Depreciation, Maintenance, Operation, etc. Average Load (Kw.) | | |
|---|---|---|---|
| | 40,000 W. P. & S. Aux. | 80,000 W. P. & S. Aux. | 80,000 W. P., S. Aux. and Gas Producer |
| Hydroelectric plant | $335,970 | $335,970 | $335,970 |
| Auxiliary steam plant, excluding coal | 185,860 | 297,840 | 297,840 |
| Transmission line (60 miles) | 32,660 | 32,660 | 32,660 |
| Gas-producer plant, excluding coal | ..... | ..... | 621,070 |
| Coal at $1 per ton | 13,680 | 324,350 | 551,400 |
| Total | $568,170 | $990,820 | $1,838,940 |
| Credits: | | | |
| Ammonium sul. at $60 per ton | ..... | ..... | $1,240,800 |
| Tar at $4 per ton | ..... | ..... | 74,840 |
| | | | $1,315,640 |
| Net cost of power | $568,170 | $990,820 | $523,300 |
| Cost per kw.-year | $14.20 | $12.39 | $6.54 |
| Cost per hp.-year | 10.60 | 9.23 | 4.88 |

kw., will supply the additional power required at the arsenal at an early date, and will furnish such power as is needed in the construction of the hydroelectric plant. Such a steam plant can be constructed in one year under normal conditions. In case of emergency it could be constructed within six months.

# ANALYSIS OF DAMAGE CAUSED BY LIGHTNING

## Information Secured from Central Station Companies in Thirteen States and Suggestions Made Concerning Protection Against Lightning

BY C. W. PIPER
School of Electrical Engineering, Purdue University

Extensive investigations of the damage done to electrical equipment by lightning have been made at the School of Electrical Engineering, Purdue University, by F. Scott and R. F. Schuck. In securing information on this subject letters were sent to 300 electrical companies, asking five definite questions. The companies were distributed over thirteen north-central states—Indiana, Illinois, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Nebraska, North and South Dakota, Ohio and Wisconsin. For this reason it is fair to assume that the data secured are representative of the damage to power companies in this section. Of the thirty-five or forty companies which replied, 90 per cent have had trouble due to lightning and 45 per cent had had their generative and distribution systems seriously damaged.

The accompanying table contains a list of different pieces of electrical apparatus and indicates the relative number of companies which reported trouble therewith due to lightning and the relative amount of damage to the apparatus, compared with the total damage from lightning.

As shown by the table, 75 per cent of the companies replying reported damage to transformers. The damage to this apparatus represented 36 per cent of the total damage by lightning. The high susceptibility to damage is due to the placing of transformers in exposed positions (as by connecting them directly to a line which subjects them to lightning and line surges).

Many meters are damaged because there is more of this type of apparatus than any other, and because they are always placed on incoming and outgoing lines where they are especially subjected to lightning surges. Insulators are damaged often because they are exposed and unprotected. Fifteen per cent of the companies reported damage to generators. This percentage is a fair indication of the damage to revolving machinery in general, since the generator is, probably, the most important and costly apparatus used, and no doubt all damage would be recorded.

The extent of arrester damage is comparatively large. This seems reasonable, as arresters are always placed so as to receive any abnormal surge before it reaches other apparatus. The damage reported on the remaining apparatus listed is comparatively small. This does not necessarily indicate that less of this apparatus has been damaged, but rather that no record was kept, as it did not directly interfere with service. Furthermore, the cost of fuses, lamps, poles, etc., is negligible, compared with costs of other equipment.

Some localities are more subject to disturbances than others, because the section may be at a higher altitude than the surrounding country, or because it is difficult to obtain good grounds for the arresters. One company stated that its trouble was confined almost wholly to a section that was formerly swampy ground, explaining that since the soil was made of decayed vegetable matter it was almost impossible to secure a good ground. Most trouble occurred either where too few arresters were used or where they were improperly placed.

Arresters were formerly installed in a haphazard way. This was not due to negligence, but rather to the lack of information on correct methods of installation. In many cases arresters were placed quite a distance from the apparatus they were intended to protect, so there was a chance of lightning striking between the two, thus preventing the arresters performing their function. In practically every case arresters were placed at the power house and substation, and in many cases at the ends of the lines and at regular intervals along the line.

From this survey, the following rules for the installation of lightning arresters were derived: Install arresters (1) on first pole outside of stations and substations where lines are overhead; (2) as near as possible to all risers; (3) where branch lines are tapped off; (4) at the crest of hills; (5) at every transformer rated at 10 kw. or greater; and (6) on the same pole with the transformer or apparatus they are to protect.

If an iron or copper wire that is grounded at frequent intervals is run a few feet above the transmission line enough protection to justify its expense will be secured. Consideration should also be given to the following: The best arrester made is absolutely worthless unless it has a good ground. For station grounds, heavy copper or iron plates should be embedded in carbon to such a depth that they will be in damp soil the entire year. For line grounds, iron pipe should be driven to such a depth that the lower end is always in damp ground, and the wire from the arrester should be soldered to the top. Wire should never run down inside the pipe, for under this condition the pipe acts as the short-circuited secondary of a transformer, and chokes back the flow of current to ground. Inclosing arresters in iron boxes tends to produce the same effect.

ANALYSIS OF DAMAGE TO APPARATUS FROM LIGHTNING

| Apparatus | Per Cent of Companies Affected | Per Cent of Total Damage |
|---|---|---|
| Arc lamps | 3 | 2 |
| Arresters | 12 | 6 |
| Fuses | 10 | 5 |
| Fuse blocks | 12 | 6 |
| Generators | 15 | 7 |
| Incandescent lamps | 3 | 2 |
| Instruments (switchboard type) | 5 | 4 |
| Insulators | 17 | 8 |
| Lines | 10 | 5 |
| Meters | 25 | 12 |
| Oil switches | 10 | 5 |
| Poles | 3 | 2 |
| Power houses destroyed | 3 | 2 |
| Transformers | 75 | 36 |

Ground wires for arresters should not be smaller than No. 6 B. & S. gage. All bends should be avoided. If a turn is necessary, sharp angles should be avoided. In addition all joints should be carefully soldered. The air gaps should be kept free from dirt and foreign matter.

Protection from a direct stroke of lightning is very difficult. The cost of protective apparatus which can be relied upon in case of direct stroke is so great as to make its use prohibitive. A greater number of arresters could be used in many cases to advantage, but economy must be considered in the installation of protective devices. One engineer says: "It is not a good policy to burden a system with devices to stop all trouble. It is cheaper to have the line burn down occasionally than have it completely protected." Considering the disadvantages of interruption to service, however, and the fact that arresters cost relatively little compared with other electrical apparatus, it is better to have too many arresters than too few. Damage can also be minimized by not placing transformers in elevated positions. The location of arresters is an important consideration. Placing them as near as possible to the apparatus to be protected seems to be the present tendency. Companies that are following this rule are apparently suffering the least damage.

# STATION AND OPERATING PRACTICE

*A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy*

## DECREASING FUEL USED PER KILOWATT-HOUR

### Contest Conducted by a Texas Company in Which Station Attendants Are Encouraged to Improve Plant Economy

To secure the highest plant economy possible the Houston (Tex.) Light & Power Company offers a prize of $50 to the station crew making the best operating

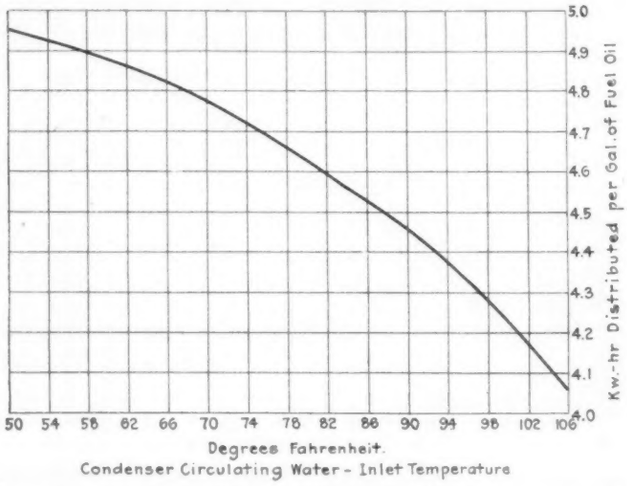



FIG. 1—RELATION BETWEEN CONDENSER COOLING WATER TEMPERATURE AND ENERGY DISTRIBUTED PER UNIT OF FUEL

record for three consecutive months. The points made by each crew are based upon the number of kilowatt-hours which can be generated per gallon of fuel with good operation. Since this ratio is different for differ-

FIG. 2—METHOD OF DISPLAYING BOGIE AND PERFORMANCE OF CREWS COMPETING IN CONTEST

ent times of the year, due to the change in condenser water inlet temperature, a curve was drawn to show the ratio or bogie that would serve as a fair basis for judging the results of the different crews.

The bulletin board shown in the accompanying illustration is placed just outside Chief Engineer W. A. McDonald's office and serves to keep each crew familiar with the others' results. The bogie mentioned is shown on the board as indicated in the next to the last column of the accompanying table, together with the points or

TABLE I.—RESULTS OBTAINED DURING TEN MONTHS

| Month | Kw.-Hr. Generated per Gal. Oil | Kw.-Hr. Dis. per Gal. Oil | Bogie | Per Cent of Bogie |
|---|---|---|---|---|
| January | 5.00 | 4.52 | 4.79 | −5.70 |
| February | 5.11 | 4.62 | 4.77 | −3.20 |
| March | 5.00 | 4.54 | 4.55 | −0.22 |
| April | 4.89 | 4.44 | 4.51 | −1.55 |
| May | 4.90 | 4.48 | 4.55 | 1.54 |
| June | 4.92 | 4.40 | 4.23 | 4.02 |
| July | 4.88 | 4.42 | 4.34 | 1.84 |
| August | 4.80 | 4.37 | 4.38 | 0.00 |
| September | 4.83 | 4.40 | 4.32 | 1.85 |
| October | 4.97 | 4.56 | 4.45 | 2.41 |

percentages secured by the crews. The prize of $50 is awarded as follows: Engineer, $15; fireman, $15; switchboard attendant, $10, and oiler, $10.

As the men change shifts every month the advantages of variations in load and operating conditions are evenly balanced between them. Great interest is shown in the contest by the men, and the company is profiting as the fuel per kilowatt-hour is at present 10 per cent less than it was in March, 1916, when the bulletin board was first put up.

TABLE II.—CONSECUTIVE DAYS' RESULTS COMPARED IN KW.-HR. PER GALLON OF OIL

| Date | Day Watch | Evening Watch | Day Watch |
|---|---|---|---|
| November 23 | 5.233 | 5.013 | 4.687 |
| November 24 | 5.168 | 5.000 | 4.894 |

The monthly results from January to October, 1916, inclusive, which are shown on the bulletin board but do not appear in the illustration on account of the use of red chalk in some of the columns, are shown in Table I. In Table II is shown the method of comparing consecutive days' results.

---

## Flash Lamp Used for Phasing Cables

Under ordinary circumstances cable men of the Commonwealth Edison Company, Chicago, use 110-volt lamps and energy from the company's mains to flash a code of signals in phasing out cables. Sometimes, however, it is necessary to connect up an isolated piece of cable at the ends of which no energy source is available. In such instances use is made of ordinary flashlight equipment for locating the phases.

The man who is at what is called the sending end of the cable, and who knows which conductor should be the A phase, which the B phase and which the C phase, connects a pocket flash lamp between phase A and the cable sheath. The other tester, who is equipped with a miniature lamp in a small socket, attaches one lead from

the socket to the cable sheath, and by touching the cable conductors one at a time with the other lead can locate phase A, since his lamp and the one at the sending end both light. When phase A has been located simple code signals are flashed and then the other phases are located in a similar manner.

It is important that both miniature lamps used in this testing be of the same rating, because if they are not one lamp will glow but the other filament will remain dark.

## Trolley Retriever for Test Leads

Where testing of motors for grounds, etc., is done with current taken from a switchboard, the leads for carrying the current are generally made several feet long to reach heavy machines which cannot be easily moved. For keeping such leads out of the way, the Knoxville (Tenn.) Railway & Light Company uses an old trolley retriever. Flexible leads are used, current being supplied to them through two slip rings attached to the retriever. The leads reach 10 ft. when unwound. When not in use the retriever promptly coils them on its drum.

## REDUCING WASTE OF SUPPLIES

### Cost of Frequently Used Materials Impressed Upon Employees by Posters

On page 273 of the Feb. 10 issue of the ELECTRICAL WORLD was described a method employed by the Consumers' Power Company, Jackson, Mich., to impress employees with the value of supplies, in that way preventing waste. The table which was presented, showing costs of materials, has been revised to agree with the present prices and is shown herewith. This table with a foreword is posted in all the company's plants and on all trucks. The foreword points out that every piece of material should earn its cost, just as should every hour of labor. Employees are expected to properly conserve and care for the small materials in the same way they would protect the more valuable property of the company.

COSTS OF MATERIALS LISTED IN POSTER

| | |
|---|---|
| Anchors and rods | $ 1.00 each |
| Batteries (dry cells) | .35 each |
| Bolts, machine, ⅜ x 4½ | 10.00 per M. |
| Brooms | .50 each |
| Brushes 2½ x 1¼ x ¾ | .43¾ each |
| Brushes, 2¼ x 1¼ x ½ | .34 each |
| Brushes, metite | 1.69 each |
| Crossarms, 8-ft. | .60 each |
| Crossarms, 5-ft. | .40 each |
| Electrolyte KD | 1.00 per gal. |
| Fire extinguisher (container) | 6.50 each |
| Fire extinguisher (Pyrene) | 4.00 per gal. |
| Gasoline | .20 per gal. |
| Grease (transmission) | .05 per lb. |
| Hose, garden, ¾-inch | .18 per ft. |
| Insulating compound (G. E. 184) | .75 per gal. |
| Insulators (17,000-volt) | .25 each |
| Insulators (40,000-volt) | 1.00 each |
| Insulators (70,000-volt) | 2.10 each |
| Insulators, suspension type | 1.26 each |
| Lamps, 25 watt Mazda | .27 each |
| Lamps, 40 watt Mazda | .27 each |
| Lamps, 60 watt Mazda | .36 each |
| Lamps, 100 watt Mazda | .65 each |
| Motor bearings, 5 hp. | 2.08 per set |
| Motor bearings, 15 hp. | 4.50 per set |
| Oil—engine | .22 per gal. |
| Oil—cylinder | .48 per gal. |
| Oil—transil | .20 per gal. |
| Paint (floor enamel) | 2.35 per gal. |
| Packing | 1.25 per lb. |
| Rectifier tubes | 25.00 each |
| Relay contacts (Tirrill reg) | 2.75 per set |
| Rings—A. C. collec. 900 r.p.m. | 75.00 per set |
| Rings—A. C. collec. 1200 r.p.m. | 55.00 per set |
| Screws, ½ x 5-in. lag | .0157 each |
| Solder—wire | .30 per lb. |
| Solder—bar | .30 per lb. |
| Soldering paste | .12 box |
| Switch-bars—K-12 oil | 4.50 each |
| Switch fingers—K-12 oil | .50 each |
| Tape (friction), 2 rolls to lb. | .25 lb. |
| Waste (white) | .11 lb. |
| Waste (wiping rags) | .08 lb. |
| Wire, No. 10 B. & S. r. c. | .05 per ft. |
| Wire, No. 12 B. & S. r. c. | .04 per ft. |
| Wire, No. 14 B. & S. r. c. | .03 per ft. |
| Wire, band, .072 steel | 1.50 per lb. |
| Wire, 5-16 in. stranded (5000) | 65.82 per reel |
| Scrap copper | .30 lb. |

## DETERMINING SIZE OF MOTOR FOR PUMPING

### Graphical Method of Calculating Required Rating of Motor That Takes Pump Efficiency Into Consideration

BY W. F. SCHAPHORST

In the accompanying illustration is shown a chart for determining the power or size of electric motors desirable to install for pumping purposes. The result applies to average conditions, and includes the pump efficiency,

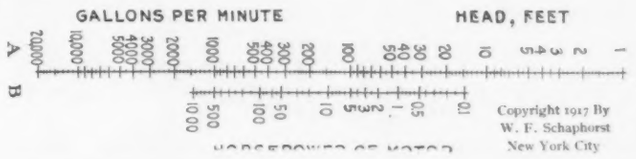



CHART FOR DETERMINING HP. OF MOTOR FOR PUMPING WATER

friction of water in piping, etc. For example, what size of motor will it take to pump 2000 gal. of water per minute against a head of 10 ft.? Find the point midway between 10 and 2000 in column A. Opposite that point will be found the answer—9 hp.

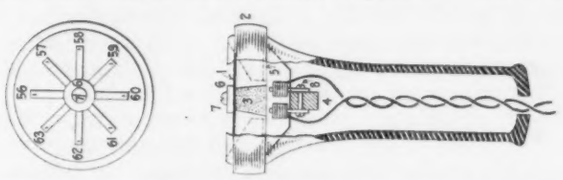
To find the mid-point, there are many quick and simple ways, such as dividers, a ruler, etc. The chart may also be used backwards to find the number of gallons per minute that a given motor will pump, or it will give the head against which a given motor will pump a given quantity of water.

## A HOMEMADE TYPE OF FREQUENCY INDICATOR

### Reconstructed Telephone Receiver with Eight Vibrators in Place of Diaphragm Labeled with Natural Frequency

In the absence of a more expensive instrument, a frequency indicator which gives good results has been constructed by the writer from a telephone receiver as follows:

Eight strips of 0.006 in. spring steel 5/64 in. wide by 2 in. long marked (1) in the top view of the receiver shown in the accompanying illustration were clamped radially between two burrs (6) on the cork (3) by means of a wood screw (7). The contacting metal surfaces were tinned and sweated together. The whole



FREQUENCY INDICATOR MADE FROM TELEPHONE RECEIVER

was then mounted on the diaphragm of a telephone receiver (5) by means of beeswax. The magnet had been previously removed from the receiver, and the brass screw (8) replaced by one of steel.

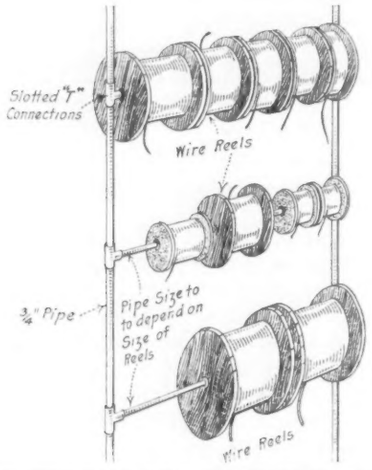
For use with 110 volts it was found necessary to use a 400-ohm resistance in series. In calibrating this device a motor-generator of adjustable frequency was used in

connection with a standard instrument. After setting the machine at 56 cycles, one of the springs was carefully clipped off at the end, piece by piece, until it set up a strong vibration. The machine was then raised to 57, and the operation repeated with the next spring, and so on up to 63 cycles. Each spring thereafter vibrated only in response to the frequency to which it was adjusted.

## CONVENIENT RACK FOR WIRE

### Axis for Supporting Wire Reels of Various Sizes Mounted in Slotted T Fittings

Various sizes of wire on small reels are conveniently stored on a rack of 0.75-in. pipe, built 7 ft. high by 3 ft. wide and supported 9 in. from the wall, at the South Deerfield (Mass.) office of the Greenfield Electric Light & Power Company. Slotted "T" fittings are attached to the vertical standards at various heights to enable horizontal pipes to be laid in place and removed with the utmost facility. The horizontal pipes are used to support the reels, the smaller ones being carried on ⅜-in. pipe. Any reel can be rolled on its support easily. The frame holds fifteen various-sized reels without crowding.




HOME-MADE WIRE RACK THAT HOLDS VARIOUS-SIZE REELS

## COST OF CONDUIT INSTALLED

### Data Presented to the Massachusetts Commission by the Boston Company in the Recent Street-Lighting Case

Among recent data presented in the Boston Edison street-lighting case by the company for consideration of the Massachusetts Gas and Electric Light Commission are the costs of various sizes and types of transmission conduit laid in the city of Boston. Particulars of general engineering interest drawn from these data are presented in the accompanying table. The prices include engineering incidentals and contractor's profit.

In the compilation given herewith the significant data are the types of construction and the unit costs, which are given in the first and last columns. In presenting the data to the commission the unit costs given, which are the result of the company's extended experience, were applied to the quantities in the second and third columns, and later the prorated cost of conduit for street-lighting service only was deduced. The quantities are printed in connection with the unit costs in the third column to show the relative importance of the various types of duct construction for underground transmission work in Boston proper.

COST OF INSTALLING DIFFERENT KINDS OF DUCT

Under the heading "Material," F. stands for fiber, V. C. for vitrified clay, C.-L. I. P. for cement-lined iron pipe, and I. for iron.

| | Ducts per Conduit | Diameter of Ducts (In.) | Material | Conduit Feet | Duct Feet | Average Cost per Duct Ft. (Cents) |
|---|---|---|---|---|---|---|
| Under dirt sidewalk | 6 | 3½ | F. | 9312.0 | 55,872.0 | 45 |
| Under dirt | 8 | 3½ | F. | 4502.1 | 36,016.8 | 30 |
| | 10 | 3½ | F. | 16.3 | 163.0 | 30 |
| | 12 | 3½ | F. | 402.2 | 4,826.4 | 30 |
| | 16 | 3¾ | V. C. | 58.5 | 936.0 | 25 |
| Under granite blocks with cement grout and concrete base | 8 | 3 | C.-L. I. P. | 1705.8 | 13,646.4 | 60 |
| | 12 | 3 | C.-L. I. P. | 25.0 | 300.0 | 45 |
| | 20 | 3 | C.-L. I. P. | 245.0 | 4,900.0 | 35 |
| | 30 | 3⅜ | V. C. | 584.0 | 17,520.0 | 30 |
| Under wooden blocks with concrete base | 4 | 3 | C.-L. I. P. | 1319.6 | 5,278.4 | 80 |
| | 6 | 3¾ | V. C. | 141.7 | 850.2 | 75 |
| | 8 | 3½ | F. | 7702.3 | 61,618.4 | 60 |
| | 12 | 3½ | F. | 953.5 | 11,342.0 | 45 |
| | 14 | 3¾ | V. C. | 929.1 | 13,004.6 | 40 |
| | 24 | 3⅜ | V. C. | 802.9 | 19,269.6 | 30 |
| Under bitulithic cement | 4 | 3 | C.-L. I. P. | 1365.3 | 5,461.2 | 80 |
| | 6 | 3¾ | V. C. | 1467.3 | 8,803.8 | 75 |
| | 8 | 3¾ | V. C. | 90.6 | 724.8 | 60 |
| | 9 | 3⅜ | V. C. | 3899.0 | 35,091.0 | 45 |
| | 10 | 3 | C.-L. I. P. | 400.1 | 4,001.0 | 45 |
| | 12 | 3½ | F. | 171.8 | 2,061.6 | 45 |
| | 12 | 3¾ | V. C. | 153.1 | 1,837.2 | 45 |
| | 15 | 3¾ | V. C. | 280.7 | 4,210.5 | 40 |
| | 18 | 3⅜ | V. C. | 77.3 | 1,391.4 | 35 |
| Under macadam | 2 | 3¾ | V. C. | 319.9 | 639.8 | 60 |
| | 4 | 3½ | F. | 394.5 | 1,578.0 | 50 |
| | 4 | 3 | C.-L. I. P. | 829.1 | 3,316.4 | 50 |
| | 4 | 3¾ | V. C. | 160.0 | 640.0 | 50 |
| | 6 | 3½ | F. | 8812.2 | 52,909.2 | 45 |
| | 8 | 3¾ | V. C. | 3579.1 | 30,632.8 | 30 |
| | 8 | 3½ | F. | 9634.0 | 77,072.0 | 30 |
| | 10 | 3½ | F. | 3306.6 | 33,066.0 | 30 |
| | 12 | 3½ | F. | 8171.9 | 98,062.2 | 30 |
| | 12 | 3 | C.-L. I. P. | 846.8 | 10,161.6 | 30 |
| | 12 | 3⅜ | V. C. | 56.7 | 680.4 | 30 |
| | 14 | 3½ | F. | 2096.9 | 29,356.6 | 25 |
| | 14 | 3¾ | F. | 182.1 | 2,549.4 | 25 |
| | 16 | 3½ | F. | 727.4 | 11,638.4 | 25 |
| | 20 | 3¾ | V. C. | 9.1 | 182.0 | 25 |
| | 24 | 3½ | F. | 239.8 | 5,755.2 | 25 |
| | 30 | 3¼ | V. C. | 196.4 | 5,892.0 | 25 |
| | 67 | 3⅜ | V. C. | 6.0 | 402.0 | 25 |
| Under asphalt | 6 | 3¾ | V. C. | 28.0 | 168.0 | 75 |
| | 6 | 3½ | F. | 330.2 | 1,981.2 | 75 |
| | 7 | 3½ | F. | 87.5 | 612.5 | 60 |
| | 8 | 3½ | F. | 230.5 | 1,844.0 | 60 |
| | 10 | 3½ | F. | 1534.2 | 15,342.0 | 45 |
| | 12 | 3¾ | V. C. | 591.7 | 7,100.4 | 45 |
| | 15 | 3¾ | V. C. | 11.2 | 168.0 | 40 |
| | 18 | 3½ | F. | 14.4 | 259.2 | 35 |
| | 30 | 3¾ | V. C. | 126.0 | 3,780.0 | 30 |
| | 32 | 3⅜ | V. C. | 16.0 | 512.0 | 30 |
| Under granite blocks | 3 | 3 | C.-L. I. P. | 68.4 | 205.2 | 50 |
| | 4 | 3½ | F. | 10.3 | 41.2 | 50 |
| | 4 | 3⅜ | V. C. | 1509.7 | 6,038.8 | 50 |
| | 6 | 3 | C.-L. I. P. | 715.3 | 4,291.8 | 45 |
| | 6 | 3½ | F. | 270.3 | 1,621.8 | 45 |
| | 8 | 3⅜ | V. C. | 7212.2 | 57,697.6 | 30 |
| | 8 | 3 | C.-L. I. P. | 7059.4 | 56,475.2 | 30 |
| | 9 | 3¾ | V. C. | 2417.2 | 21,754.8 | 30 |
| | 10 | 3 | C.-L. I. P. | 71.5 | 715.0 | 30 |
| | 10 | 3½ | F. | 1396.4 | 13,964.0 | 30 |
| | 12 | 3⅜ | V. C. | 2189.5 | 26,274.0 | 30 |
| | 12 | 3 | C.-L. I. P. | 7882.7 | 94,592.4 | 30 |
| | 12 | 3¾ | V. C. | 889.3 | 10,671.6 | 30 |
| | 12 | 3½ | F. | 4904.8 | 58,857.6 | 30 |
| | 14 | 3¾ | V. C. | 20.3 | 284.2 | 25 |
| | 15 | 3¾ | V. C. | 6753.7 | 101,305.5 | 25 |
| | 15 | 3½ | F | 154.1 | 2,311.5 | 25 |
| | 18 | 3¾ | V. C. | 193.5 | 3,483.0 | 25 |
| | 18 | 3½ | F. | 344.5 | 6,201.0 | 25 |
| | 24 | 3 | C.-L. I. P. | 249.3 | 5,983.2 | 25 |
| | 24 | 3½ | F. | 223.5 | 5,364.0 | 25 |
| | 30 | 3⅜ | V. C. | 586.4 | 17,592.0 | 25 |
| Under granite blocks with pitch-joints and concrete base | 4 | 3 | C.-L. I. P. | 4960.3 | 19,841.2 | 80 |
| | 6 | 3 | I. | 19.6 | 117.6 | 75 |
| | 6 | 3⅜ | V. C. | 216.6 | 1,299.6 | 75 |
| | 8 | 3 | I. | 147.6 | 1,180.8 | 65 |
| | 8 | 3⅜ | V. C. | 1092.8 | 8,742.4 | 65 |
| | 8 | 3 | C.-L. I. P. | 9673.9 | 77,391.2 | 65 |
| | 10 | 3½ | F. | 8089.8 | 80,898.0 | 45 |
| | 11 | 3 | C.-L. I. P. | 120.7 | 1,327.7 | 45 |
| | 12 | 3½ | F. | 346.6 | 4,159.2 | 45 |
| | 12 | 3⅜ | V. C. | 5165.8 | 61,989.6 | 45 |
| | 18 | 3 | C.-L. I. P. | 208.1 | 3,745.8 | 35 |
| | 24 | 3 | C.-L. I. P. | 205.0 | 4,920.0 | 30 |
| | 30 | 3 | C.-L. I. P. | 101.4 | 3,042.0 | 30 |
| | 30 | 3⅜ | V. C. | 237.0 | 7,110.0 | 30 |

# CENTRAL STATION SERVICE

*A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat*

## DINNER FOR TWENTY TAKES ONLY 6 KW.-HR.

### Roast of Beef Shrank but 5.8 Per Cent in Weight While Cooking with Electricity, Which Required Almost Three Hours

Further figures showing the economy of operation of an electric range are given by T. H. Kettle of the Minneapolis General Electric Company. An electrically cooked dinner was given to the sales department on the occasion

*THE MINNEAPOLIS GENERAL ELECTRIC CO.*
*SALES DEPARTMENT'S ELECTRICAL DINNER*
*HELD TUESDAY, MARCH 20, 1917.*

*MENU.*

Tomato Soup

Olives — Radishes — Celery

Rolls

Roast Beef

Baked Potatoes — Stewed Apples — Scalloped Corn

Combination Salad

Cake

Prune Whip

Coffee

ENERGY TO COOK THIS MEAL WAS 0.3 KW.-HR. PER FERSON

of one of the monthly meetings to discuss the lesson of the commercial engineering course of the N. E. L. A. The meal was cooked by the members of the company's electric cooking bureau, and accurate records were kept of costs, weights, shrinkage, etc. The results were:

| | |
|---|---|
| 1. Number of people served | 20 |
| 2. Total cost of supplies | $8.54 |
| 3. Total kilowatt-hours used | 6 |
| 4. Kilowatt-hours per person served | 0.3 |
| 5. Total cost of energy at 2½ cents | $0.15 |
| 6. Weight of roast before cooking | 9 lb. 10 oz. |
| 7. Weight of roast after cooking | 9 lb. 2 oz. |
| 8. Per cent shrinkage | 5.8 per cent |
| 9. Total cost of meal | $8.69 |
| 10. Total cost per person per meal | $0.434 |

All of the cake and rolls were made during the afternoon and baked on the electric range just before the dinner was served, and in addition to this the two demonstrators and the range salesman waited upon customers all afternoon. For this reason no portion of their time was charged to the actual preparation of the meal.

The roast beef was placed in the oven at 3.10 and was taken out at 6 o'clock, and it was found to be perfectly cooked. The electric range used in preparing this dinner was not put into operation before 2.30 in the afternoon.

## WHAT IT COSTS TO SERVE SMALL COMMUNITIES

### Data Compiled by Wisconsin Company Show Whether or Not Service Can Profitably Be Extended

More and more central station service is being extended into small outlying communities, and rural districts are more and more demanding service. Uppermost in the minds of the station manager is the question "Will it pay?" Data on actual installations of this character undoubtedly furnish the most satisfactory method for arriving at an answer.

At the recent convention of the Wisconsin Electrical Association G. W. McIvor, Jr., presented a paper on this topic which contained considerable data on a number of installations in small Wisconsin towns.

As regards their disposition the earnings from the sales of electricity in towns served by transmission lines can be divided into three parts, Mr. McIvor pointed out, namely, interest on the investment, depreciation of property and operating expenses. The relative cost of the first two items is easily determinable. An allowance of 6 per cent per annum for each, or 12 per cent of the original investment, must be taken out of earnings to pay these costs. The third item, however, is not a fixed quantity and does not bear a definite relation to the original investment. It varies widely, depending on local conditions. Overhead is generally the determining factor. In a small town operated from a district office operating expense may be as low as 8 per cent to 15 per cent of the earnings; but in a town where it is necessary to maintain an office and a manager the operating expense will rise from 15 per cent to 25 per cent. Putting one manager in charge of several small towns will, of course, decrease the proportion of operating expense to be deducted from the earnings of each town, but even so it is not conservative to use a percentage under 20 in estimating the operating expense.

SUMMARY OF OPERATING RESULTS AND COSTS FOR TEN SMALL WISCONSIN TOWNS FOR 1916.

| | Population | Connected Load | Kilowatt-Hours Per Annum | Kilowatt-Hours Per Capita | Operating Exp. | Earnings | Operating Ratio % | Sub-station Capacity | Substation: Total Cost | Substation: Cost Per Kw. | Distribution System: Total Cost | Distribution System: Cost Per Capita |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 417 | 28 | 12,226 | 30 | $230 | $1,549 | 14.8 | .. | .... | .... | $3,144 | $7.55 |
| B | 425 | 20 | 7,864 | 20 | 145 | 940 | 15.5 | .. | .... | .... | 3,944 | 9.28 |
| C | 678 | 58 | 45,502 | 68 | 423 | 3,674 | 11.5 | 100 | $3,898 | $38.98 | 4,781 | 7.05 |
| D | 1,474 | .. | 112,800 | 77 | 378 | 2,528 | 15.0 | 100 | 3,573 | 35.73 | .... | .. |
| E | 523 | 43 | 19,090 | 36 | 259 | 2,331 | 11.2 | 100 | 2,533 | 25.33 | 4,542 | 8.52 |
| F | 700 | 127 | 64,641 | 92 | 2,194 | 4,788 | 45.8 | 100 | 779 | 7.79 | .... | .. |
| G | 1,000 | 136 | 93,821 | 93 | 1,784 | 6,928 | 65.8 | .. | 742 | .... | .... | .. |
| H | 250 | 16 | 3,546 | 12 | 9 | 462 | 1.95 | 50 | 2,431 | 48.65 | 5,707 | 22.00 |
| I | 527 | 56 | 32,958 | 63 | 529 | 3,170 | 16.7 | 100 | 1,784 | 17.50 | 4,373 | 8.30 |
| J | 765 | 140 | 72,768 | 95 | 328 | 1,481 | 22.2 | 100 | 750 | 7.85 | 4,373 | 8.30 |
| Average .... | 675 | 70 | 47,521 | 58 | $627 | $2,785 | 22.0 | 100 | $2,061 | $24.23 | $4,415 | $10.60 |

Analyses of the costs of actual installations of several small towns, A, B, C, D, E, F, G, H, I, J, on the transmission lines of a Wisconsin company are given in the accompanying table. These towns are served from lines operating at potentials of from 6600 to 66,000 volts, 60 cycles, single-phase and three-phase. The average cost per kilowatt for substations in these communities was as follows: On 33,000-volt lines, $33.35; on 13,200-volt lines, $17.50, and on 6600-volt lines, $16. The cost per mile of transmission line to the communities, in one case using a 33,000-volt, three-phase, No. 6 copper line, was $1,334; in another case, using a 13,200-volt, single-phase, No. 6 copper line, it was $1,082, and in another case, using a 6600-volt, single-phase, No. 6 copper line, it was $1,020. All lines carried a ground wire.

As shown in the table, the population of the towns ranges from 250 to 1474 and the average is 675; the connected load varies from 16 kw. to 140 kw. and the average is 70 kw.; the annual sale of energy in 1916 varied from 3546 kw.-hr. to 112,800 kw.-hr. and the average was 47,521 kw.-hr.; the energy sold per capita ranged from 12 kw.-hr. to 95 kw.-hr. and the average was 58 kw.-hr.; the annual operating expenses varied from $9 to $2,194 and the average was $627; the earnings ranged from $462 to $6,928 and the average was $2,728; the percentage of earnings required for operation varied from 1.95 per cent to 65.8 per cent and the average was 22 per cent; the substations cost from $7.79 to $48.65 per kilowatt and the average cost was $24.23; the costs of the distribution system ran from $7.05 per capita to $22.80 per capita and the average was $10.60.

With these data compiled from its existing lines the company is at all times able to decide quickly whether or not it can profitably extend its service. A study of the data has revealed that it is not profitable to give service to a local distributing system owned municipally or otherwise; it is believed that the profit in the business is not sufficient to support a middleman. The averages shown in the table are materially affected by two cases where energy is sold to a local distributing company. As a general rule the company believes, however, that small communities within reasonable transmission distance can be served at rates which compare favorably with those in larger towns, except at times when labor and material prices are abnormal.

---

## A RATE THAT ENCOURAGES SOCKET APPLIANCE LOAD

### Experience of Southern Sierras Power Company with Rate Designed for Electric Cooking but Available for All Customers

Practically every central station which has devoted attention to putting electric ranges on its system has first established a rate specially designed for electric cooking. Socket appliances also use this rate and as a result their sale has increased because they can be operated more cheaply than on the lighting schedule.

This condition has been capitalized by the Southern Sierras Power Company by putting into effect a rate designed specially for electric cooking but available for all consumers whether users of electric ranges or not. This rate carries a minimum of $1.50 per month, which covers the installation of the separate meter, subject to which 4 cents per kilowatt-hour is charged for the first 50 kw.-hr., 3.5 cents per kilowatt-hour for the next 50 kw.-hr., and 3 cents for all in excess of 100 kw-hr. per month. Under these terms, if a consumer could ordinarily use more than 50 kw.-hr. per month in socket appliances, it would be worth his while to apply for the cooking rate.

With this rate in effect the company has been able to encourage the more generous use of socket appliances and has provided its appliance salesmen with the best possible inducement to offer the prospective purchaser.

---

## CENTRAL STATION SERVICE AND HEATING PROBLEMS

### Several New England Operators Emphasize Difficulties Met With in Plants Where Heating and Electric Demands Are Non-Coincident

The treatment of the steam-heating problem was discussed at some length at the recent "question box" convention of the New England Section of the N. E. L. A. at Boston, Mass. The various speakers emphasized the difficulties of installing central station service in plants where the heating and electric service demands are non-coincident. It was pointed out by G. F. Parsons of C. D. Parker & Company, Boston, that night service in isolated plants may be very expensive under some conditions. He advocated a careful investigation of load and heating demands with respect to the time of their occurrence. A point that helps the central station is that in isolated plants the heating pipes must be large in order to keep the exhaust pressure low. With central station operation the raising of steam pressure on cold days is feasible without other drawbacks.

Instances were cited by A. C. Jordan, Portland, Me., where the engineering conditions of the isolated plant were unfavorable to its retention. In one factory the cost of heating was excessive on account of the location of the radiating surface on the ceiling, and the results were unsatisfactory in cold weather. In another shop a steam hammer was a difficult feature from the standpoint of central station service. This was changed to air service, with motor drive of the compressor. Five other hammers similarly driven are now in service in Portland. The importance of equipping radiator returns with traps and of reducing the coal consumption on Sundays and holidays was pointed out. In one plant where 8000 lb. of coal were used for Sunday heating central station service has been installed, and by modernizing the piping system, stopping leaks and reducing the pressure from 80 lb. to 20 lb. the plant is heated by 3000 lb. of coal per day in the coldest weather. Scientific plant management on the low-pressure "steam end" of installations taken over by central stations helps the latter to maintain and increase savings due to the use of their service.

Mr. Jordan spoke of the good results of purchasing $800 worth of steam-flow meters for the use of the power sales department of the Cumberland County Power & Light Company. By adding two extra movements and two extra nozzles at a cost of about $54, the department is able to measure from 6000 lb. to 54,000 lb. of steam per hour, thus covering a wide range of commercial conditions. In the course of the discussion it was brought out that in the last two years at Portland the cost of power sales work was about 18 per cent of the estimated revenue. The average revenue figured per horsepower of connected load per year in power installations is $12.

The cost of the first group of power reports made by a central station to prospective customers is not important, D. S. Boyden, Boston Edison company, stated, because new business of this kind can be obtained afterward in large measure by less elaborate methods based on estimated costs and showing the prospective user what has been accomplished in typical installations.

The wastefulness of flat-rate service in central station heating was emphasized by V. M. Tallman, Worcester (Mass.) Electric Light Company. This year 48 per cent of the Worcester company's heating service is metered, compared with 20 per cent a year ago. It is important to know the total condensation of return lines and of the general system. Automatic air valves on radiators are desirable. Customers can be educated to economical service with meters installed, whereas the opposite is true with flat rates. This year the company's heating revenue is 43 per cent more than last, on account of the use of meters and better control of the heating demands of customers. The rates are the same as last year. The Worcester company's meter rate is $1.50 per 1000 lb. of steam condensed. Closing, the speaker said that the ordinary building as laid out by the average steamfitter has probably twice the radiating surface needed.

In one plant where central station service appears favorable to the most economical operation, according to H. D. Stokes, Worcester, the coal cost was cut down 60 per cent by stopping the practice of feeding cold water to the boilers and other wasteful measures. The steam pressure in the piping of the plant was cut from 80 lb. to 25 lb. by eliminating a steam-driven fire pump, which increased the insurance rate only $100. With an electrically driven fire pump good protection could be secured with a saving in expense.

## COST OF ELECTRIC HEATING IN SHOE FACTORY

### Average Energy Consumption per 100 Pairs of Shoes for Heating Service Over Eight-Month Period Was 16.55 Kw.-hr.

Extended data as to the cost of electric heating in a Brockton, Mass., shoe factory were presented at the recent "question box" convention of the New England Section of the N. E. L. A. by D. M. DeBard of the Edison Electric Illuminating Company of Brockton. In this establishment thirteen machines are provided with electric heat, and in the eight months ended Feb. 28, 1917, the total energy consumption for this service was 19,600 kw.-hr., the number of pairs of shoes manufactured being 118,359. The average energy required per 100 pairs of shoes was about 16.55 kw-hr. The energy consumption of the several machines for heating service was as follows in the months of maximum and minimum shoe production:

| Number Pairs Manufactured | August, 1916 16,998 Kw.-Hr. | | November, 1916 12,490 Kw.-Hr. | |
|---|---|---|---|---|
| | Total | Per 100 Pairs | Total | Per 100 Pairs |
| Two Goodyear stitchers | 369 | 2.2 | 348 | 2.8 |
| Two Goodyear welters | 232 | 1.4 | 192 | 1.5 |
| Two pulling-over machines | 616 | 3.6 | 83 | 0.7 |
| Four box toe machines | 724 | 4.3 | 700 | 5.6 |
| One bottom drier | 741 | 4.4 | 638 | 5.1 |
| One bottom filler | 211 | 1.2 | 178 | 1.4 |
| One Gem insole machine | 72 | 0.4 | 43 | 0.4 |
| | 2965 | 17.5 | 2182 | 17.5 |

It will be noticed that while the energy per 100 pairs of shoes is apparently a constant, except for the pulling-over machines, the energy consumed is much less for quantity production. For manufacturing or other reasons the energy consumption of the pulling-over machines was much greater in August than in the following November.

## FORMS DESIGNED FOR CUSTOMER'S CONVENIENCE

### Boston Edison Company Introduces Two New Forms for Use in Connection with Telephone Communication

In talking with an electric light company office over the telephone customers frequently are subjected to long delays, transfers and other inconveniences because of the departmental system of the office. Efforts are constantly being made by progressive companies to find methods to expedite telephone service in a way helpful to the customer.

Two forms designed for just such a purpose have

FORM TO BE USED FOR TELEPHONE APPLICATIONS

District
Service Wanted
Date
No. ... St. / Ave.
Town
Name
The name must be furnished as customer will sign App.
Suite or Room
Phone No.

Discontinuance to be made at old address Yes / No When?
Approximate Load ... lamps ... H. P. ... Miscell.
New or Old Wiring

CREDIT INFORMATION
Customer at / Former Customer at ... St. / Ave.
Other Address
Reference
Remarks

Taken by
Date

The E. M. I. Co. of B. Form 1205 5M 12-16

THE CUSTOMER BY MEANS OF THIS FORM MAY OBTAIN SERVICE AT NEW HOME WITHOUT A WHOLE LOT OF RED TAPE

recently been introduced by the Edison Electric Illuminating Company of Boston and, it is claimed, are proving very serviceable. The upper form of the two here reproduced is to be used for receiving telephone applications for service. It can be used by any one liable to receive rush orders by telephone for the purpose of starting a "dummy" application where service is already installed on the premises and permits are not required.

It will be noticed that the form is for the information of the credit department as well as the application desk. Forms are sent directly from the person taking the call

The E. M. I. Co. of B. Form 1205 12-16

TO- ACCOUNTING INSTALLATIONS / APPLIANCE LAMPS / BILLING / CONSTRUCTION MAINTENANCE / ELECTRICAL ENG. SALES / INFORMATION SPECIAL SERVICE

FROM ... DEPT.

ADDRESS

NAME

DATE ... PHONE NO.

NOTES

REPORT BACK TO ORIGINATOR / CUSTOMER

Employees in Operating Bureau receiving telephone calls must use this form and avoid transferring calls to other departments.

THIS FORM ENABLES THE CUSTOMER TO TELL HIS STORY TO WHOMEVER ANSWERS PHONE

to the application desk, where a "dummy application" is filled out and sent along in regular course.

The other form, also reproduced, saves the customer's time by making it possible for him to tell his story to the first person using the telephone, instead of waiting to be transferred to some other desk or department, and perhaps "cut off" in the meantime.

# ADVANCE IN TECHNICAL THEORY AND PRACTICE

*Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World*

## ELECTRIC AUTOMOBILES

### The Field of the Electric Vehicle in Competition with the Gasoline Car and the Horse Carriage in Great Britain

AN elaborate paper on "Self-Propelled Electro-vehicles and Their Applications," by L. Brockman, is published in the *Transactions* of the Institution of Engineers and Shipbuilders in Scotland, Vol. LX, Part III, January, 1917.

The author emphasizes two reasons why the electromobile should now be strongly pushed. The first reason is the crisis in the gasoline supply (petrol is the British expression for gasoline): "After petrol—what will follow? The very success of the petrol motor has brought with it a severe shrinkage in the supply of its life-blood. In future the air service will claim priority in its demand for motor spirit over all users, and no one can possibly foresee the extent of such a demand. This crisis throws back the internal-combustion motor on new and untried fuels and chemical mixtures, the only sure knowledge about which is that they are inflammable. The engines will have to be redesigned to suit these new fuels. . . . There is a hugh capital investment in electric central station plants in Great Britain, but in America it is larger still, built up laboriously in the course of the last thirty years. Yet the capitalization of the motor car industry there has within one decade exceeded twice the sum invested in central stations. Think of the respective rate of progress, the potentialities of both endeavors, and to what excellent purpose they may be combined."

The second reason is the necessity to find some means of quickening traffic in congested British city streets. The electromobile is thought to solve the problem. "For short-distance work within restricted boundaries, entailing frequent stopping and restarting, petrol machines have proved to be neither suitable nor economical —hence horse haulage has been affected to a very small extent only by their introduction. It is an unpalatable fact that in these days of scientific enlightenment 80 per cent of the freight movement in main thoroughfares [in Great Britain] still depends on horses, which effectually puts the brake on all efforts at speeding up locomotion. . . . The great preponderance of horse-drawn lorries, etc., with rare exceptions, progresses at the rate of from 2 to 3 miles per hour—if it can make any headway at all."

Of all power vehicles, electrically driven vans and lorries have proved themselves best suited in every respect to supersede horse traction in city and suburban service for these fundamental reasons: The cost of energy is low and no power is consumed while at rest. The speed is double or treble that of horses with equal loads. They are self-starting and easily controlled by cheap labor. They have a short wheelbase, taking up a minimum space on streets and in garages. They have a reliability to 95 per cent of the working hours, due to simple mechanism, consequently the upkeep charges are low. They are clean, sanitary and free from fire risks. Smooth and rapid circulation of traffic in streets, regardless of weather conditions and steep gradients, can, therefore, be insured by their employment. Further, the inclusive expenses entailed by operating within a radius of from 8 to 10 miles from any center—or from 40 to 60 miles' run per day—compare most favorably with all other means of animal and motor traction.

The coefficient of reliability—*i.e.*, the ratio of working days in commission to total number of working days during any given period—is stated to show the fine average of 95 per cent. The relative values for other haulage systems are: Petrol lorries, 90 per cent; steam lorries, 85 per cent, and horses, according to severity of service, from 65 to 85 per cent. (In the discussion which followed the paper, J. Hully Craig thought these figures were too unfavorable to the electromobile. From records in a certain district he figured that the electric delivery wagon had shown a reliability coefficient of 99.65 per cent, while that of the steam lorry was much below 85 per cent.)

The author's conclusions as to the field of the different types of automobiles are summed up as follows: "Electric vehicles come out easily first when operating within a radius up to 10 miles from a given center. For conveying tonnage beyond that distance at high speed petrol motors are best adapted—principally in competition with railways. Time saved, handling of consignments reduced, empties returned, and many other advantages, are all factors which must be taken into account in comparing motor expenses with freight charges and setting the limit where costs outweigh benefits. Where tonnage and long distance are essentials, but more latitude can be given as regards speed of delivery, traction by steam motors, with or without trailers, makes a strong bid for consideration in England. These had not been employed long enough in the United States when the study of transport economics was undertaken by the institute to be included in its report. Horse haulage may still be able to hold its own at present, if costs alone are reckoned, and if used within a radius of 2 miles in dense territory requiring calls at every few blocks, though in any modern scheme of transport, and especially for the most congested central areas of cities, it has no rightful place whatever. But daily expenses even in this very service can be cut down by working motors on a properly organized plan. One outstanding advantage of electric vehicles is that all debit items can be determined beforehand to a small fraction of a penny. There need be no surprise costs of any kind."

The author then takes up automobile design and says: "It is only bare justice to acknowledge that the high state of development reached in the art of constructing chassis and equipments is due mainly, if not entirely, to a group of American engineers, far-seeing, resourceful men, who never faltered in their allegiance to the electric vehicle, convinced of the important part it must play in future road transportation."

Speed, distance limit, weight, price, electric troubles and recharging facilities are next considered. Several types of electromobiles of British make are briefly described, with notes on automobile batteries and motors and controllers, and very extensive data are given on the operating costs of electric automobiles under British conditions.

While the major part of the paper deals with industrial or utility automobiles and their numerous special applications, electric passenger or pleasure automobiles are also considered and the importance of practically effortless manipulation, due to the ideal simplicity of control, is emphasized.

The author concludes that the useful sphere of the electric automobile extends much beyond the bounds commonly credited and is steadily being widened. Yet the measure of power carried on board and the time and facilities necessary for replenishing it must always be borne strictly in mind, and this the car makers do to excellent purpose.

"Too much stress cannot be laid on sound garaging practice, methodical supervision and the keeping of records where users have to house and care for vehicles in their own establishments. With the return to peace conditions far-reaching facilities in that respect are sure to be developed. As the use of electromobiles becomes general, an independent organization will be called into life to occupy a place between the two groups of interested parties, namely, between manufacturers and electricity supply undertakings on the one side and electric vehicle owners on the other. Such organization will aim at providing 'service garages' in suitable localities throughout the country, where electric cars and trucks may be cleaned, charged, stored and delivered to residence or business premises. Along with this class of service another function will be to maintain vehicles permanently in full operating condition, *i.e.*, to effect needful repairs and renewals of every description, recharge or exchange batteries (to admit of day and night duty of the trucks) for an inclusive fixed fee per mile run. On that principle users need only find remunerative work for the vehicles, being fully assured as to costs for upkeep and running."

Emphasis is finally laid on the possibility of improving the load factor of the average central station by filling up the valleys in the supply curve by creating a large electromobile industry.

---

## Generators, Motors and Transformers

*Balancers for Three-Wire Systems.*—THOMAS CARTER.—In his long illustrated serial on balancers for three-wire continuous-current systems the author discusses static balancers. A static balancer consists essentially of a choking coil of two or more phases connected to two or more equidistant points on an armature winding by means of slip-rings. The author gives diagrams of a three-wire systems with a static balancer, of the method by which a transformer for a rotary converter may be used as a static balancer, and of a three-wire dynamo with a four-phase static balancer. He then discusses the method of neutralizing continuous-current magnetization in static balancers. In the two-phase arrangement it is possible to utilize the opposing directions of the two halves of the current in the balancer to cause their undirectional magnetic effects, superposed on the alternating-current magnetization, to neutralize each other by a suitable disposition of the coils or portions of them relatively to each other. This is also possible in the four-phase case, but in the three-phase case the three unidirectional magnetizations cannot neutralize each other if three simple coils are used on a three-legged core of the ordinary sort. Two modifications of the simple arrangement have been suggested to overcome this. One is to wind each limb with a second winding having a number of turns equal to only one-third of those of the choking-coil winding, and to connect these three additional windings in series to the middle wire at one end and to the star point at the other end, so that they carry $C_3$ amp., while the choking-coil windings carry one-third $C_3$ amp only. If the additional windings are so connected that their ampere-turns oppose those set up by the direct current in the choking-coil windings, then, as the two sets of ampere-turns are exactly equal, the net unidirectional magnetization is zero. The second suggestion is to have the three phases in halves, coupled up as in Fig. 1, which shows that the continuous-current magnetization would

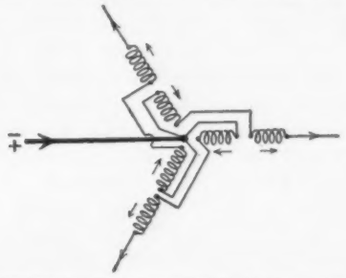


FIG. 1—ARRANGEMENT FOR NEUTRALIZING CONTINUOUS-CURRENT MAGNETIZATION IN THREE-PHASE STATIC BALANCER

thereby be neutralized in each limb. Owing to the extra weight of copper involved by the first suggestion, and the loss of output, in the ratio $\sqrt{3/2}$, in the second case, due to the halves of phases connected in series with each other not being in phase with each other, and so giving a total voltage per phase less, in the ratio $\sqrt{3/2}$, than twice the voltage of each portion, the three-phase balancer proves relatively expensive, and it is preferable, therefore, to use four phases instead of three. Generally speaking, small dynamos are fitted with two-phase balancers with two slip-rings, and the number of phases increases to four, and eventually to six, as the size of the generator increases. Beyond six the balancing does not greatly improve, and it is not economical to spend more money on extra rings and subdivision of windings on the balancer, as the advantage is so small. The author next discusses the voltage variation on unbalanced loads with static balancers and, finally, gives a note on the tapping of armature windings for connections to static balancers.—London *Electrician*, March 2, 1917.

## Lamps and Lighting

*Principles of Good Lighting.*—P. G. NUTTING.—A Franklin Institute paper on the fundamental principles of good lighting. The author discusses at considerable length vision with steady, nearly uniform, field brightness, and vision in contrasting fields, with applications to practical lighting. He concludes that the best seeing requires an abundance of nearly unidirectional light. The light from the sky through high, well-spaced windows is very nearly ideal. Indirect lighting from numerous sources is very bad. Semi-indirect lighting with units closely assembled and at one side is probably the best form of artificial lighting. No part of any lighting unit within the range of vision should exceed 250 millilamberts in brightness, nor should contrasts ordinarily visible exceed 100:1.—*Journal Franklin Inst.*, March, 1917.

*The Quality of Light from an Illuminant as Indicated by Its "Color Temperature."*—E. P. HYDE AND W. E. FORSYTHE.—An account of an investigation carried out at the Nela Research Laboratory. The importance of quality in the light from various illuminants has been recognized for some time, and various methods have been worked out to designate this important characteristic. The spectrophotometer may be used to determine the relative distribution of intensity in the various wave lengths of the visible spectrum, and the colorimeters of Ives and of Nutting indicate component ele-

ments which may be used to specify the color of a light source. But it is difficult from such data to visualize the resultant color. It has been found by experiments that the light from most, but not all, ordinary illuminants can be matched in color by the light from a black body operating at some particular temperature, which is called the "color" temperature of the source in question. In the case of candles, oil lamps, ordinary gas flames and incandescent electric lamps it is found that, when operating at a color match, the distribution of energy in the visible spectrum of the black body and the source is quite closely the same, although this would not necessarily follow. Data have been obtained on the color temperatures of various illuminants, and it is suggested that these be made the basis of a color scale for sources whose light is sufficiently near that of a black body in color to permit of comparison. For sources, such for example as the Welsbach mantle, whose light cannot be matched in color with that from a black body at any temperature, the method outlined above is not entirely satisfactory, but the authors have in mind a possible modification of this method which may extend its applicability to almost all practical sources. Experiment has shown that it is possible to specify the quality of light from the Welsbach mantle, whose color is somewhat greenish, by stating the temperature of a black body whose light when mixed with that transmitted by a blue-green filter and coming from a black body at a definite temperature matches that from the mantle. Further investigation is planned to determine the feasibility of some such method for those sources whose colors do not lie on the scale of color of a black body at various temperatures. Data for some of the most common illuminants are given in the table. (Degrees Kelvin are degrees in the absolute scale = 273 + deg. C.)

COLOR TEMPERATURE OF VARIOUS ILLUMINANTS

| Source | Color Temperature, °K. |
|---|---|
| Gas flame, fish-tail burner | 1870 |
| Hefner | 1875 |
| Pentane (10 cp. standard) | 1914 |
| Candle: | |
| Paraffin | 1920 |
| Sperm | 1925 |
| Kerosene lamp: | |
| Round wick | 1915 |
| Flat wick | 2045 |
| Acetylene (as a whole) | 2368 |
| One spot | 2448 |
| 2.3 w.p.h.c. Nernst glower | 2388 |
| 4.0 w.p.h.c. carbon | 2070 |
| 3.1 w.p.h.c. treated carbon | 2153 |
| 2.5 w.p.h.c. gem | 2183 |
| 2.0 w.p.h.c. osmium | 2176 |
| 2.0 w.p.h.c. tantalum | 2249 |
| 1.25 w.p.h.c. tungsten | 2385 |
| 0.9 w.p.h.c. tungsten | 2543 |
| 0.5 w.p.h.c. gas-filled tungsten | 2900 |

From these data and those on the black-body brightness temperatures, the brightness of the various illuminants may be computed.—*Journal Franklin Inst.*, March, 1917.

## Electrophysics and Magnetism

*Phase Rotation.*—C. J. FECHHEIMER.—After some general notes on phase rotation the author discusses three-phase machines and shows that the sequence of maximum value of emf. in a three-phase, three-wire system can be reversed if any two of the three wires from the supply be interchanged without in any way altering the generators; and the direction of rotation of a synchronous or induction motor may be reversed by reversing its phase rotation; that is, by interchange of any two leads. He then takes up six-phase machines and finally gives a simple general rule for effecting a reversal of phase rotation for any polyphase system. If the $n$ phases of any system be represented as in diagram $A$, Fig. 2, choose any diameter, such as $e$-$k$, and imagine the plane of the paper rotated through 180 deg. about this diameter. This results in the diagram $B$ in which for the same sequence the direction of rotation is opposite to that in $A$. Thus in diagram $C$ (an odd and prime number of phases has been purposely chosen to illustrate the application of the general rule) five phases are shown for counter-clockwise rotation for sequence of $a, b, c, d, e$. This may be reversed by rotating through 180 deg. say about the diameter through $a$, in which case $b$ and $c$ will interchange respectively with $e$ and $d$, thus obtaining diagram $D$ of opposite phase rotation. Or it may be rotated about a diameter, $MN$, at right angles to the diameter through $a$ and result in diagram $E$ of opposite phase rotation to $C$. In general, the preferable method is to choose the diameter about which the phase diagram is to be rotated so that it will coincide with the vector of one phase to neutral (or two phases, with an even number of phases).—*Elec. Journal*, March, 1917.

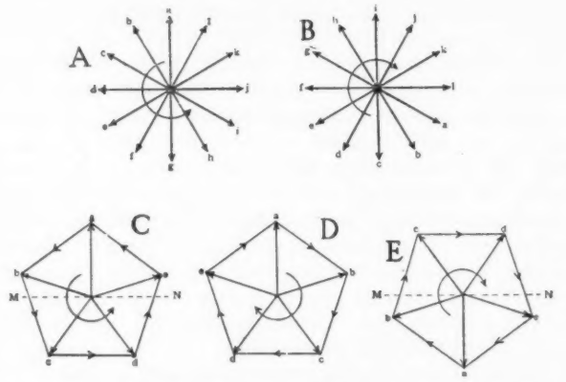



FIG. 2—POLYPHASE CIRCUITS CONNECTED TO GIVE DIFFERENT PHASE ROTATIONS

*Atomic Model.*—R. R. RAMSEY.—Modern theories of the structure of an atom assume one or more electrons in motion about a central body or positive nucleus. A mechanical model of this structure employs magnetized needles floating by means of corks in water. The present author uses instead small bicycle balls floating on mercury and rotating. A wooden tray is used with an electrode at the center and four electrodes, one at each corner, which are connected in multiple. By sending the current in at the middle electrode and out at the corners one has an approximately radial current flowing at right angles to the magnetic field of the magnet, which plays the part of the positive nucleus in the experiment. This causes the mercury to rotate and carry the balls with it. The movement of a number of balls is rather complicated. The mercury at the edges of the box is stationary while the central portion is rotating. The angular velocity increases as we go from the edge to the center. The balls floating on the surface tend to take up the same angular velocity as the mercury upon which they float. "There is a tendency for the balls to take up a motion which may approximate to planetary motion. Thus we may assume that they obey Kepler's law." The arrangement is believed to illustrate various phenomena like the production of X-rays and gamma-rays and the disintegration of an atom of radium.—*Philos. Mag.*, February, 1917.

## Units, Measurements and Instruments

*Lead Oxide Resistance Thermometer.*—S. LEROY BROWN.—The author has formerly pointed out the possibilities of utilizing the high temperature coefficient of resistance of metallic oxides for the construction of resistance thermometers. The author experimented with an oxide resistance thermometer made by thrusting two wires into a globule of molten lead oxide

and allowing it to cool so that only a thin layer of the solid oxide separates the wires. Some difficulty may be experienced by the oxide cracking on account of unequal expansion of the oxide and connecting wires. Lead oxide is easily melted in a gas flame, and when fused with iron wires makes a reliable connection which is permanent when subjected to temperatures ranging

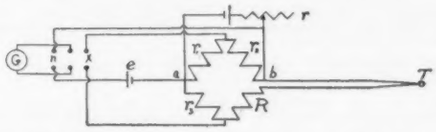



FIG. 3—CONNECTIONS FOR CONTROLLING EXCITING CURRENT

from —10 deg. C. to 120 deg. C. The resistance of such a thermometer may range from a few hundred ohms to several thousand ohms at room temperatures. The iron wires are soldered to larger copper wires near the oxide so that the variation of resistance of the leads due to variable immersion is negligible and compensating leads are not necessary. The electrical resistance of the oxides decreases as the current through them is increased, and therefore the oxide resistance thermometer must be excited with a constant current, or so nearly constant that the variation in the current does not cause an appreciable change in the electrical resistance. The plan of accurately controlling the strength of the exciting current is shown by reference to Fig. 3. The electromotive force across *ab* is maintained equal to the electromotive force of the standard cell *e* by adjusting the variable resistance *r*, and this equality is determined by throwing the galvanometer connections to *n* and balancing the electromotive force across *ab* against the electromotive force of the standard cell. The resistance from *a* to *b* is maintained constant; any increase or decrease of the resistance of thermometer *T*

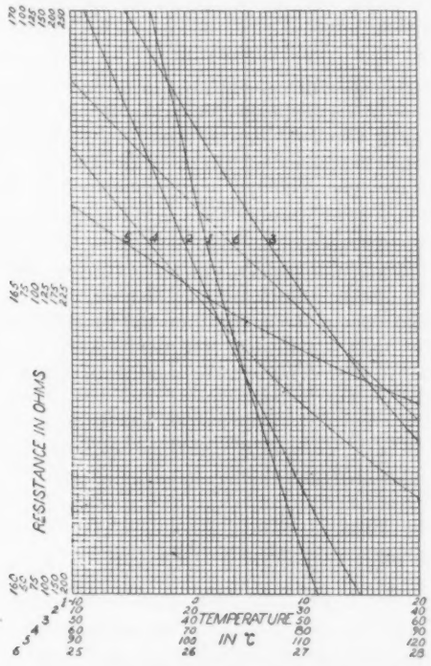



FIG. 4—VARIATIONS IN RESISTANCE OF LEAD OXIDE WITH DIFFERENT TEMPERATURE RANGES

is compensated for by a decrease or increase at *R*. The bridge arms, $r_1$, $r_2$ and $r_3$ were so chosen that 1 milliampere of current flowed through the thermometer *T* while the electromotive force across the bridge was maintained equal to the electromotive force of a standard Weston cell. The results are shown graphically by the several curves in Fig. 4, each curve extending over a temperature range of about 30 deg. C., excepting No. 6, for which the temperature range is only from 25 deg. to 28 deg. C. The steepness of these curves indicates the sensitiveness of the oxide resistance to temperature variations. A resistance thermometer of this kind does not require compensating leads, has low heat capacity, and since the junctions are close together unequal heating cannot produce thermal electromotive forces. Temperature measurements can be reproduced with the oxide resistance thermometer to within a few thousandths of a degree between 0 deg. C. and 100 deg. C. The principal disadvantage as compared to the platinum resistance thermometer is that there is no simple relation between resistance and temperature.—*Phys. Review*, March, 1917.

# Book Review

ELECTRIC CENTRAL STATION DISTRIBUTION SYSTEMS. Their Design and Construction. By Harry Barnes Gear and Paul Francis Williams. New York: D. Van Nostrand Company. 458 pages. 187 illustrations. Price, $3.50.

When the first edition of this book was published in 1910 it stood apart as a distinct practical survey and treatise of the different phases of American practice in the distribution of electrical energy generated by a central station. The developments in underground installations and city distribution have been considerable, however, during the past seven years, and this the authors have recognized in their second edition by completely revising much of the material in the first edition dealing with transmission systems and substations, overhead and underground construction. Mr. Gear's noted investigations of diversity factor and demands of customers for the system of the Commonwealth Edison Company of Chicago are reflected in the chapter devoted to distribution economics, which takes up about twice as much space as in previous edition, and covers with practical illustrations a variety of conditions in central station work including cost of service and rate considerations. This section of fifty-nine pages is well worth the price of the book, and those who have found the first edition of service will want to supplement it by the new information now available not only on this subject but on the other developments of the art as it now exists. The subjects covered in the new edition of this book are: Systems of distribution; transmission systems; substations; voltage regulation; line transformers; secondary distribution; special schemes of transformation; protective apparatus; overhead construction; underground construction; cable work; distribution economics; properties of conductors; alternating-current circuits.

## Books Received

THEORY AND CALCULATION OF ELECTRIC CURRENTS. By Charles P. Steinmetz. New York: McGraw-Hill Book Company, Inc. 362 pages. 133 illustrations. Price, $3.

HIGH-FREQUENCY APPARATUS. Its Construction and Practical Application. By Thomas Stanley Curtis. New York: Everyday Mechanics Company, Inc., 245 pages. Illustrated. Price, $2.

THE NATURE OF MATTER AND ELECTRICITY. An Outline of Modern Views. By Daniel F. Comstock and Leonard T. Troland. New York: D. Van Nostrand Company. 204 pages. Illustrated. Price, $2.

# NEWS OF THE INDUSTRY

*Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields*

## ELECTRICALLY PROPELLED BATTLE CRUISERS CERTAIN

### Time Will Be Required for Details—Opinion of Admiral Griffin—Contracts for Electrical Equipment of Battleships Awarded

The Navy Department has decided to build five battle cruisers with electrical propulsion machinery. Two of these are to be built by the Newport News Shipbuilding & Drydock Company, one by the New York Shipbuilding Company, one by the Fore River Shipbuilding Company, and another by the government at the Philadelphia Navy Yard.

#### COSTS AND EQUIPMENT

The vessels will cost about $76,000,000 for hulls and machinery. There has been fixed a limit of cost of $19,000,000 each for hulls and machinery, although there will be another expense of about $5,337,810 for arms and armament on each ship.

The ships will have displacement of 34,800 tons; they will be 850 ft. in length and 91 ft. beam. They will be of 180,000 hp. and have a speed of 35 knots per hour.

These will be the first battle cruisers built by the United States, although ships of this powerful type and high speed have been in use by England and Germany for some time. These vessels will be the first equipped with electrical propulsion, although the collier Jupiter, electrically driven, was built by the United States some time ago and has proven a great success from a naval viewpoint. The details of the electrical machinery have not yet been worked out. Several months' time will be needed for this work. In general, however, it is known and decided that the generators will be driven by steam turbines, with current on four shafts, each shaft with 45,000 hp.

#### OPINION OF ADMIRAL GRIFFIN

Rear Admiral Robert S. Griffin, U. S. N., engineer in chief, bureau of steam engineering of the Navy Department, will have general charge of the construction of the vessels. Admiral Griffin expressed to a correspondent of the ELECTRICAL WORLD in Washington the opinion that the electrical engineers of the country, as a body, are generally in favor of the electrical propulsion of naval vessels.

"You can't find two real electrical engineers in the country," Admiral Griffin said, "who are opposed to electrical propulsion."

Admiral Griffin said he had gathered the general impression from his knowledge of the subject that those who are opposed to electrical propulsion for naval vessels are those who have an interest in other methods of propulsion.

#### ELECTRICAL EQUIPMENT ON BATTLESHIPS

Of the four new battleships which are to be equipped with electric drive, the contracts for the construction of two each were awarded to the New York Shipbuilding Company and the Newport News Shipbuilding & Drydock Company. The contracts for the electrical equipment were awarded to the General Electric Company and the Westinghouse Electric & Manufacturing Company, two to each company.

## COMPLETING THE DETAILS FOR N. E. L. A. CONVENTION EXHIBITS

### Lamp Committee and Electric Vehicle Section Expected to Set High Standards in Attractive and Educational Displays

The exhibition committee of the National Electric Light Association has about completed the details in connection with the exhibits for the fortieth annual convention to be held during the week ending May 28 at Atlantic City, N. J. Plans for the decorations, if present ideas are carried out, will be unique.

The membership committee is securing many new manufacturers as members, who are not only joining the association, but also taking advantage of the opportunity to make an exhibit at Atlantic City. Class "D" members are urged by the exhibition committee to send in their applications at once.

The exhibits will be completed on Saturday night, May 26, and the exhibition will open on the ensuing Monday morning at 9 o'clock with special ceremonies.

---

## ILLUMINATING ENGINEERING SOCIETY CONVENTION

### Annual Meeting Will Be Held in Newark, N. J., During the Third or Fourth Week of September

The annual convention of the Illuminating Engineering Society will be held in Newark, N. J., during the third or fourth week of September. P. S. Young, vice-president and treasurer of the Public Service Corporation, will be chairman of the committee on the 1917 convention. The committee on time and place, composed of the vice-presidents of the five sections, in conference with Mr. Young, will decide upon a definite date.

Preston S. Millar, chairman of the committee on papers, has reported to the council of the society that three papers have been scheduled definitely and several are under negotiation. Ten brief papers to form a symposium on color are listed.

A committee on diffusing media has been authorized, with I. G. Priest, associate physicist of the Bureau of Standards, as chairman.

---

## JOVIAN PROBLEMS TO BE STUDIED BY A COMMISSION

### Ways and Means of Improving Relations with Local Electrical Leagues to Be Considered in Cleveland on April 3

A commission appointed to devise ways and means to improve existing relations between the Jovian Order and local electrical leagues will meet at the club rooms of the Cleveland Electric League, Cleveland, on April 3. The commission was appointed by Reigning Jupiter Henry L. Doherty in accordance with a resolution passed at the last Jovian annual convention. Mercury Ell C. Bennett is chairman of the commission.

# INJUNCTION HALTS NATIONAL ELECTRICAL CODE MEETING

## Restrained from Considering the Subject of Fuses by the Supreme Court, Electrical Committee Adjourns Biennial Meeting

The 250 or more electrical inspectors, city electricians, underwriters, manufacturers, engineers, etc., from various sections of the country who had assembled in the large auditorium of the New York Board of Fire Underwriters on Wednesday to attend the biennial meeting of the electrical committee of the National Fire Protection Association were greatly surprised when one minute after the session was called to order by Chairman G. E. Cabot it was summarily adjourned. The object of the meeting was to consider changes and additions to the National Electrical Code, and the only inkling that most of those assembled had of any trouble was given in the form of a resolution read immediately after the meeting opened. The resolution was as follows:

> Whereas the maker of a certain electrical service device has brought suit in the New York Supreme Court against all the members of this committee and has obtained a restraining order which not only enjoins the committee as a body from taking any action disapproving of this device, but prevents us as individuals from saying or doing anything which any person might interpret as being unfavorable to the device; and
>
> Whereas we have engaged counsel to protect our interests in the litigation and have been advised by the counsel that the character of the restraining order is such as to render inadvisable any general discussion at this time of any subject that may come before the committee,
>
> Be it therefore resolved, that the committee now adjourn subject to the call of the chairman.

Inquiry developed that earlier in the week the various members of the electrical committee were served with an injunction order issued by Judge Delehanty of the Supreme Court of the State of New York to the Economy Fuse & Manufacturing Company, argument on which was heard by the court on Thursday, the defendants being represented by ex-District Attorney Jerome of New York City and the plaintiffs by Platt & Field.

The complainants in the case brought suit against every member of the electrical committee, which, as is well known, includes many representatives of professional and trade associations who are not interested in the insurance business at all.

### THE BASIS OF COMPLAINT

The plaintiff, which manufactures a certain type of refillable fuse, in asking for the injunction claimed that many profitable contracts have been made, that it has large unfilled orders on hand, is making many other profitable contracts with users for its fuses, and will renew and continue in the future to renew contracts if not threatened by the acts of the defendants. Its fuses, it maintains, have been tested by the Underwriters' Laboratories, Inc., and certified by it at various times as complying with the requirements of the code.

The immediate and direct cause of the action was the resolution adopted by the switch and cut-out committee to be presented at the March 28, 1917, meeting, which was as follows:

"Sec. d. The switch and cut-out committee has continued its investigation and study of the subject of refillable fuses, and desires to report the following opinion: 'The evidence presented to or obtained by the committee does not warrant it in recommending any change in Rule 68 d.' "

The injunction served restrained the defendants, both individually and as switch and cut-out committee and as electrical committee, their agents, servants, employees, attorneys and agencies through which they act, from taking any vote, passing any resolution, doing any act or having any communication, either oral or written, the purpose or the effect of which will be or that will cause or tend to cause:

(1) The customers of the Economy Fuse & Manufacturing Company to break contracts to purchase fuses from said company.

(2) The customers of the Economy Fuse & Manufacturing Company to refuse to renew contracts to purchase fuses from said company.

(3) Persons, firms or corporations desirous of becoming customers of the Economy Fuse & Manufacturing Company from making contracts for the purchase of Economy fuses.

(4) Any persons, firms or corporations using fuses or about to use fuses to infer that said defendants either individually or as members of either of said committees have condemned the Economy fuse as a fire hazard, a dangerous device or one which it is not proper to use.

(5) Any persons, firms or corporations using fuses or about to use fuses to believe that the Economy fuse is a dangerous and hazardous device.

(6) The withdrawal or annulment of permission or permissions heretofore granted for the sale and purchase, installment and use of the Economy fuse.

(7) Refusals to grant further permissions in the future to purchase and sell, install and use Economy fuses.

(8) Or to call, or that will call or tend to call, attention to the fact that the fuse manufactured by the Economy Fuse & Manufacturing Company is not recognized by the defendants' National Electrical Code; and

(9) Or that will be to declare or lead others to believe that the Economy fuse is not a proper device to be recognized by said defendants' National Electrical Code, or the purpose or effect of which will be to discriminate against the Economy fuses in favor of the fuses of competitors of the Economy Fuse & Manufacturing Company.

### STATEMENT BY UNDERWRITERS

Speaking to a representative of the ELECTRICAL WORLD, an official of the National Fire Protection Association said that ample notice of the next meeting of the committee would be given to the technical and business press as well as to the various inspection departments. He regretted the postponement of the meeting and the expense to which many were put in coming to New York needlessly, but said that the action was advised by counsel for the protection of the committee.

It was pointed out that many inspection departments having jurisdiction have permitted the installation of certain types of refillable fuses so as to obtain the necessary field experience on their behavior in practice. Moreover, the Bureau of Standards has made a thorough study of the fuse in question at the request of both the manufacturer and the underwriters and has published its findings in an elaborate report. The Bureau of Standards recommended "that Economy fuses be not approved at present for general use on the same basis as fuses now listed as standard by the Underwriters' Laboratories, Inc., but that a continuation and extension of their use be permitted by municipal and underwriters' inspection departments under conditions where their performance can be observed by each inspection department until sufficient experience regarding their performance under service conditions can be obtained to justify an unqualified approval or refusal to approve."

# ELECTRICAL COUNCIL FOR THE UNDERWRITERS' LABORATORIES

## New Organization Formed to Supervise Work of the Electrical Department, Which Grows in Volume and Importance

An electrical council has been organized by the Underwriters' Laboratories to supervise the work of its electrical department. Such supervision has been done heretofore by the fire council of the Laboratories, but the volume and importance of the work have grown so much that a special council is necessary.

### F. E. CABOT HONORED

In connection with the initial meeting of the electrical council, held at the Machinery Club, New York, on the evening of March 28, the retirement of F. E. Cabot of Boston as a member of the fire council after twenty-five years' service was announced. Mr. Cabot continues as chairman of the electrical committee of the National Fire Protection Association and secretary of the Boston Board of Fire Underwriters. In honor of his long and valuable service his associates presented him with a gold watch.

The members of the new electrical council are:

### ACTIVE MEMBERS OF THE ELECTRICAL COUNCIL

L. A. Barley, electrical inspector, Rocky Mountain Fire Underwriters' Association, Denver, Col.
R. C. Bird, inspector, Fire Underwriters' Electrical Bureau, New York, N. Y.
W. S. Boyd, electrical inspector, The Union, Chicago, Ill.
G. E. Bruen, superintendent electrical department, Suburban Fire Insurance Exchange, New York, N. Y.
W. J. Canada, Bureau of Standards, Washington, D. C.
B. W. Clark, electrical inspector, Public Lighting Commission, Deroit, Mich.
H. H. Clark, electrical engineer, experiment station, Bureau of Mines, Pittsburgh, Pa.
James Cole, commissioner of wires, Boston, Mass.
W. Devereux, chief electrical department, Philadelphia Fire Underwriters' Association, Philadelphia, Pa.
J. C. Forsyth, electrical inspector, New York Board of Fire Underwriters, New York, N. Y.
B. H. Glover, associate engineer, Underwriters' Laboratories, Chicago, Ill.
C. H. Hill, chief electrical inspector, Underwriters' Association of the Middle Department, Philadelphia, Pa.
M. F. Jones, chief electrical inspector, New England Bureau of United Inspection, Boston, Mass.
C. E. Lum, National Board of Fire Underwriters, New York, N. Y.
W. D. Matthews, superintendent of inspections, Chicago Board of Underwriters, Chicago, Ill.
A. H. Miner, Jr., United Bureau of New England, Boston, Mass.
C. W. Mitchell, inspecting engineer, Board of Fire Underwriters of the Pacific, San Francisco, Cal.
I. Osgood, chief engineer, Boston Board of Fire Underwriters, Boston, Mass.
A. M. Paddon, engineer, Underwriters' Association of New York State, Syracuse, N. Y.
Dana Pierce, vice-president, Underwriters' Laboratories, New York, N. Y.
A. M. Schoen, chief engineer, Southeastern Underwriters' Association, Atlanta, Ga.
E. H. Sigison, manager, Buffalo Association of Fire Underwriters, Buffalo, N. Y.
H. F. Strickland, chief electrical inspector, electrical inspection department, Hydro-Electric Power Commission of Ontario, Toronto, Ont.
R. P. Strong, chief electrical inspector, Louisiana Fire Prevention Bureau, New Orleans, La.
Ralph Sweetland, engineer-in-charge, New England Insurance Exchange, Boston, Mass.
Victor H. Tousley, chief electrical inspector, municipal department, Chicago, Ill.
A. G. Wilbor, Factory Insurance Association, Hartford, Conn.
H. S. Wynkoop, electrical engineer, Bureau of Electrical Inspection, New York, N. Y.

### CORRESPONDING MEMBERS

H. M. Beecher, chief inspector, Department of Electricity, Los Angeles, Cal.
F. A. Cambridge, city electrician, Winnipeg, Man.
M. E. Cheney, electrical engineer, Washington Surveying and Rating Bureau, Seattle, Wash.
R. L. Daniel, engineer, General Inspection Company, Minneapolis, Minn.
F. O. Evertz, electrical inspector, Ohio Inspection Bureau, Columbus, Ohio.
J. H. Fenton, electrical inspector, St. Louis Fire Prevention Bureau, St. Louis, Mo.
Oscar M. Frykman, chief electrical inspector, Building Department, Minneapolis, Minn.
Warren Hadley, electrical engineer of District of Columbia, Washington, D. C.
C. H. Hodgson, chief electrical inspector, Allegheny County Board of Fire Underwriters, Pittsburgh, Pa.
W. B. Hubbell, chief electrical inspector, Cincinnati Fire Prevention Bureau, Cincinnati, Ohio.
Howard A. Jocelyn, city electrician, Seattle, Wash.
F. H. Moore, chief inspector, city electrical department, Indiana Inspection Bureau, Indianapolis, Ind.
J. R. Morrissey, superintendent electrical department, Wisconsin Inspection Bureau, Milwaukee, Wis.
William Lincoln Smith, secretary National Association of Electrical Inspectors, Concord, Mass.
H. H. Sutton, chief electrical inspector, State Insurance Commission, Austin, Tex.
C. M. Tait, chief electrical inspector, Canadian Fire Underwriters' Association, Montreal, Canada.
E. W. Trafford, city electrician, Richmond, Va.
F. D. Varnum, city electrical inspector, St. Paul, Minn.
H. G. Veit, chief electrical inspector, Cleveland Inspection Bureau, Cleveland, Ohio.
F. D. Weber, electrical inspector, Underwriters' Equitable Rating Bureau, Portland, Ore.

---

# PROGRAM FOR ANNUAL MEETING PACIFIC COAST SECTION, N. E. L. A.

## Commercial, Engineering and Public Policy Sessions with Wide Range of Subjects and Addresses by Prominent Men

Program details have been announced for the first annual convention of the Pacific Coast Section of the National Electric Light Association, which is to be held at Riverside, Cal., April 19, 20 and 21. The convention committee is under the chairmanship of A. B. West, Southern Sierras Power Company, Riverside.

On Thursday, the first day, after the registration and reception of members, there will be an open meeting at which welcome will be extended by Riverside civic officials. Reply will be made by John A. Britton, Pacific Gas & Electric Company. The secretary and treasurer and the membership committee will report.

On Thursday afternoon will be the opening of the commercial committee session. Subjects discussed will be: Rates, merchandising of lamp socket devices, electric cooking and water heating, and highway lighting. At 8 p. m. on the same day there will be an illustrated address on the Southern Sierras Power Company's system by C. O. Poole, the chief engineer.

### ENGINEERING SESSION FRIDAY

On Friday morning the commercial committee session will be continued. The subjects will be: Industrial electric heating and commercial organization. The report of the accounting committee will be read.

On Friday afternoon the engineering committee session will be held, and at its close the nominations and election of Pacific Coast Section officers will take place. Subjects for discussion at the engineering committee session are: Standardization of distribution transformers; report of conferences with engineers of California Railroad Commission on general safety order affecting line construction; suspension insulators; standardization of pin and clevis hardware for suspension insulators; inductive interference; fuse protection of transformers and branch lines in rural distributing systems; joint pole construction; operation of steam turbine standby stations; high-head waterwheels.

At 8 p. m. the report of the public policy committee will be read and thereafter short addresses will be presented by Max Thelen, president of the California Railroad Commission; John S. Mitchell, Los Angeles Chamber of Commerce; O. B. Coldwell, representing the Northwest Electric Light & Power Association, and H. M. Byllesby of Chicago. The program will be concluded with an illustrated lecture by W. D'Arcy Ryan.

### INSPECTION TRIP FOR SATURDAY

Saturday will be devoted to an automobile trip to the crest of the San Bernardino Mountains. Luncheon will be served at Pine Crest by the Southern Sierras Power Company. In returning the party will stop at the San Bernardino steam generating station and the substation at Colton. The convention will close on Saturday night with a ball at the Glenwood Inn.

# STATE HYDROELECTRIC OWNERSHIP KILLED IN MAINE

## Comprehensive Report by an Electrical World Representative on the Disposal of Plan to Emulate the Ontario Commission

By recent votes in the House and Senate sustaining an adverse report of the Judiciary Committee on the Dutton bill, the Maine Legislature has effectually disposed of any early prospects of a State hydroelectric system development along the lines of the Ontario Hydro-Electric Commission's work in Canada. At the present session hydroelectric matters have occupied a prominent place on the calendar. Questions of State policy under discussion included the Dutton bill, providing for the establishment of a water-power commission similar to that in Ontario; the Baxter bill, providing for the transfer of water-power investigations from the Public Utilities Commission to an independent board, and a bill introduced on March 27 to repeal the existing statute prohibiting the transmission of hydroelectric power from Maine to another state.

The Judiciary Committee has decided that the Baxter bill ought not to be passed and will shortly render this report. It is expected that the interstate transmission bill will be vigorously contested.

To a representative of the ELECTRICAL WORLD Governor Milliken said on Monday of this week that the present policy of the State is opposed to the sale beyond its borders of energy generated in Maine, the encouragement of local industrial upbuilding being the foundation of this policy. Maine has the highest per capita water-power development and the third largest total development in the Union.

The Governor declared to the ELECTRICAL WORLD representative that the State should proceed as rapidly as possible to acquire full knowledge of its water-power resources, and that while later developments might modify the present ban upon interstate transmission from Maine, no company can transmit power at present outside the State if the prohibition of the general law is contained in its charter. The proposed repeal of the interstate ban already has a substantial backing in the Legislature.

### MAINE UNWILLING TO ATTEMPT GOVERNMENT OWNERSHIP

The Dutton bill on behalf of public ownership was a storm center of discussion in the committee hearings. Among its supporters was Gifford Pinchot, who was unable to visit Augusta, however, to give his views.

The principal witness on behalf of the bill was P. B. Yates, manager of electric service at St. Catharines, Ont., associated with the engineering department of the Ontario Hydro-Electric Commission. Mr. Yates described the work in Ontario at great length, stating that the commission now supplies 140 municipalities and distributes 200,000 hp. of energy generated at Niagara and in other plants. It has been found practicable to distribute power to farm customers even if three per mile of line can be secured. Iron wire is generally used on such jump-offs, however.

A 5-hp. motor, Mr. Yates said, if mounted on skids, suffices for the greater part of the farm work. The witness claimed that a diversity factor of five exists among the farming installations and that 100 hp. supplied to a township will meet the needs of 500 farms. The witness cited many of the low rates in vogue on the system, and contended that the work is handled efficiently by the commission. Work has been started on the construction of a 200,000-hp. plant at Queenstown Heights to operate under 305-ft. head. An ultimate development of 1,000,000 hp. is planned.

C. B. Carter, for the Central Maine Power Company, Cumberland County Power & Light Company and other utilities, brought out the point that there never has been an audit of the books of the Ontario commission by an outside auditor. At the end of 1915 the province of Ontario had given the commission $924,000, which was not figured in its costs up to 1916, and in 1916 the province advanced $127,000 to cover the activities of the board.

E. F. Merrill, also counsel for the central station interests, declared that the Dutton bill is unconstitutional. The Supreme Court of Maine in Brown vs. Gerald (100 Maine) has held that the creation and distribution of power for manufacturing purposes is clearly a private enterprise, no matter how great its general utility. This decision held that to enable the right of eminent domain to be exercised in such behalf would be taking the property of one private person for the use of another private individual, "which is not legislation, but robbery."

### ARBITRARY POLITICAL POWER OF ONTARIO COMMISSION

Mr. Merrill said that the Ontario commission obtained power at Niagara for $9 per horsepower-year practically under threat of eminent domain. "When legal action was threatened against the commission, this great political machine forced through the Canadian Parliament a statute which provides that all suits in which the authority of the commission shall be called in question should be forever stayed. Under our constitution things are not done that way," said Mr. Merrill.

"They passed another statute that no action at law should be brought against the commission without the consent of the Attorney-General," he continued. "I have been unable to find a single case where the Attorney-General has granted his consent to bring such an action. It has been further provided that when the commission is acting within any powers granted to it by Parliament, its action shall not be reviewable by any court."

Mr. Merrill pointed out that the Maine constitution limits the State to taking on any indebtedness above $300,000; that the Ontario commission has already expended $40,000,000 on its transmission system and its service, and that the bill was one of the most dangerous pieces of legislation ever proposed in Maine.

Reginald P. Bolton, consulting engineer, New York, outlined the work of the Ferris committee in New York State, which investigated the Ontario system and reported against a similar scheme of state ownership of water powers in New York.

Mr. Bolton referred to the loss of $128,000 shown in the Cleveland (Ohio) municipal lighting plant by an expert accountant's report in 1915, and intimated that low rates are a snare and a delusion under such conditions. Mr. Bolton said that it is impossible to obtain as high efficiency of labor under public ownership as under private operation, and contended that the Ontario commission's rates were too low in relation to costs.

### ENERGY SOLD BELOW ENGINEERS' ESTIMATES

P. W. Sothman, consulting engineer, New York, chief engineer of the Ontario commission from 1906 to 1912, said that he resigned from the board's employ because he could not agree with its financial methods.

"Being chief engineer," he said, "my duty was to make out estimates and figures down to the final point on which the cost of power was to be fixed. I don't believe in a single instance our figures were adopted and presented to the municipalities or to the party or parties asking for the cost of power."

The witness said that in 90 to 95 per cent of the cases energy was sold at far below the engineers' estimates.

He stated that in Europe most of the plants originally publicly owned are going over to the privately owned companies and that plants making a fair success under public ownership make a great success after about two years of private ownership and operation. In closing, Mr. Sothman declared that the published reports of the Ontario commission do not reveal the true cost of electricity.

Walter S. Wyman, general manager of the Central Maine Power Company, pointed out that the cost of rendering its service is far less in proportion to the volume of business concerned than is the case in Ontario. In 1915 the commission expended $2,800,000 to take power from Niagara and deliver it to the consumer. The Central Maine company, under private management and deducting taxes (no taxes are paid by the Ontario municipalities), handled about one-eighth of the business of the Ontario system at a cost of about $210,000. It is hoped to be able to pay a common-stock dividend before long.

Nearly all the stockholders live in the company's territory, there being 1100 in Maine. The greater part of the stockholders are customers. Almost every Maine savings bank has invested in the securities of the Central Maine Company.

### Equitable Rates in Maine

Mr. Wyman referred to the power of the Ontario commission to drop substantial loads to keep down the peak and to the increased rates in vogue as the distance from Niagara Falls increases. In spite of the sparsely settled territory, the Maine company's rates are the same on country roads as in town. There are 1180 farm customers and the lines run in some cases from five to twelve miles into the country to serve them.

The company is obliged to maintain a steam turbine reserve station at Farmingdale capable of handling 75 per cent of the system peak load. Sixteen plants supply the system and there are no large stations, as at Niagara. Energy is sold to the Lewiston, Augusta & Waterville Street Railway at 8 mills per kilowatt-hour. The system represents an investment of about $10,000,000.

Mr. Wyman said that with very large steam turbines a total generating cost of about 4.25 mills may be anticipated. He said that the mean low run of the Kennebec River is under 1000 hp. at 12-ft. head, dropping for two or three days to 500 hp.

Municipal ownership, Mr. Wyman declared, is absolutely inefficient, and one of its serious defects is the opportunity it affords to try freakish experiments whose real cost may not be known for months. In conclusion, he referred briefly to the economic benefits of a high-tension electrical trunk line from upper Maine into eastern Massachusetts which might serve as a kind of interstate busbar of electrical supply, absorbing surplus energy at one point for use elsewhere under proper control.

The Baxter bill, designed as stated above to transfer the investigation of water-power resources from the Public Utilities Commission to an unpaid board, to be known as the Maine Water Power Commission, was introduced by Representative Baxter of Portland.

The author of the bill informed a representative of this journal that the sole object of the measure was to facilitate the development of the State's hydroelectric resources through comprehensive investigation. Proponents of the bill contended that members of the Public Utilities Commission should be relieved of the burdens of water-power investigation.

The opposition, which included representatives of the electric service companies, held that the commission is entirely capable of handling the work; that if additional engineering assistance is required the work can be done at less cost than by a new and separate official organization; and it objected on the additional ground that it might prove to be a step toward public ownership.

The commission is entirely willing to continue the work and to broaden the inquiry.

---

## HEAVY WINDSTORM TESTS CINCINNATI PREPAREDNESS

### Long-Standing Preparations for Emergency Prove Their Value When Cyclonic Wind Strikes a Section of the City

A heavy windstorm in Cincinnati during the evening of March 23 gave the Union Gas & Electric Company an opportunity to test its preparations for such a dangerous emergency. Long before this cyclone struck the city, long before the last previous severe windstorm about two years ago in fact, the company had made definite plans to hasten the work of reconstruction. Francis R. Healy, superintendent of distribution, in describing the result of the storm says:

"Always prepared for catastrophes of this or any other sort, our company has an organized emergency crew, men who are reached by the simple SOS call. The time of evening—7.45 officially—would ordinarily make the chance of need of such a crew a very slight one; nevertheless, within half an hour we had 100 men on the ground.

"Company automobiles hurried them to the scene, and by noon of the next day, despite night and drenching rain, they had the main arteries working again. But that did not repair the damage.

"All in all, this wind, which, as you read of it, took perhaps two blocks on Grace Avenue, Hyde Park, and possibly the territory for one city block on either side at most, cost us between $4,000 and $5,000."

HEAVY WINDSTORM TESTS CINCINNATI PREPAREDNESS FOR EMERGENCY

# COMBINING UTILITIES WITH THE OIL BUSINESS

## Cities Service Company Enlarges Its Scope and Adds Materially to the Sources of Gross Earnings —Power Business Growing Rapidly

The growing importance of the oil and refinery business in the operations of the Cities Service Company is shown by the 1916 statement. Of the total gross earnings of the holding company, $5,573,116 were from utilities and $4,537,227 from oil and refineries. The combined statement of earnings of all subsidiary companies shows that the gross of those properties was $48,052,573.

In addition to the great change in the operations and business resulting from further development of the oil business a conspicuous feature of the year was the high rate of growth of electric central station companies.

### ORDERS FOR TURBINES OF 200,000 HP.

"In spite of the large additions to plant equipment reported last year," says President Henry L. Doherty, "we have been compelled to place orders for additional turbine capacity for the electric properties aggregating 200,000 hp. This includes 67,000 hp. for Toledo, 22,000 for Warren (Ohio), 16,500 each for Denver and Empire District (Mo.), 11,000 for Elyria (Ohio), and smaller units for almost every other electric property.

"The progress of your Ohio properties is especially noteworthy. Last year we reported that the Massillon company had doubled its capacity in 1914 and again in 1915. We now have equipment ordered which will more than double the present capacity.

"The Trumbull company at Warren has been similarly called upon to increase its turbine capacity from 10,500 hp. to 33,000 hp., and the Lorain County company at Elyria from 9500 hp. to 20,000 hp.

"Work on a new power station for Toledo has been started. The first installation will be 54,000 hp. The output is now practically three times as great as when your company became interested four years ago.

"The growth of the Southwestern companies has been practically as rapid, and the commercial development of the Empire District, St. Joseph (Mo.), Hutchinson (Kan.) and Salina (Kan.) properties is gratifying.

"Conditions have improved materially in most of the Southern properties, and we have ordered adequate equipment to handle the additional business offered at Durham (N. C.), Bristol (Va.) and Athens (Ga.)."

### HIGHER COSTS WILL AFFECT NET EARNINGS

Mr. Doherty regards the outlook for increased gross earnings of the various utility properties as the brightest in the history of the company. "But the net earnings," he adds, "will be affected by the increased costs of fuel, materials and labor. Taxes, already a large factor in operating costs, are rapidly increasing because of new federal and state legislation. Economies effected through increased volume of business and higher efficiencies obtainable from the new equipment now being installed will be a material factor in alleviating these conditions."

The judgment of the directors is that "the company is fully equipped for whatever eventualities may develop during the year, and a continuance of increasing earnings seems to be assured."

To cover briefly the extensive operations of the company in oil: At the end of 1916 28,000 bbl. of oil daily were being marketed and stored. The refineries have facilities for handling 30,000 bbl. of crude oil daily. Their equipment includes 1157 tank cars, with 385 additional on order, several ocean steamers and storage capacity of 1,800,000 bbl. The Empire Pipeline Company has 180 miles of pipelines, with 176 additional under construction, and has storage tanks of 1,400,000 bbl. capacity with accessory gathering lines and pump stations. Operations in the Eldorado and Augusta (Kan.) fields have fully proved 24,000 acres.

Earnings compare as follows:

| | 1916 | 1915 |
|---|---|---|
| Gross earnings | $10,110,343 | $4,479,800 |
| Expenses | 239,390 | 172,856 |
| Net earnings | $9,870,953 | $4,306,944 |
| Interest on notes and debentures | 258,960 | 490,000 |
| Net to stock | $9,611,993 | $3,816,944 |
| Dividends preferred stock | 2,409,691 | 1,570,005 |
| Net to common stock and reserves | $7,202.302 | $2,246.939 |

# SAFEGUARDING THE COAL SUPPLY OF BROOKLYN COMPANY

## Plans to Secure Adequate Reserve, Take Advantage of Low Summer Prices, Avoid Shipping Delays and Eliminate Possible Embargo

Plans of the Edison Electric Illuminating Company of Brooklyn and the Kings County Electric Light & Power Company for safeguarding the coal supply are set forth in the combined annual report of these properties to shareholders. The report, signed by N. F. Brady, president, and W. F. Wells, vice-president and general manager, and also secretary to the board of directors, says on this point:

"To insure an adequate coal supply, take advantage of low prices during the summer, avoid shipping delays often encountered in obtaining coal during the winter and eliminate possible embargo on coal consignments by the railroad companies, some 37 acres of waterfront property were purchased near Rossville, Staten Island, which will be utilized for the storage of a reserve supply of coal. The company has under way the construction of a concrete bulkhead wall along this entire waterfront, and is installing a large-capacity overhead traveling crane which will be utilized in handling coal when received from the mines and in reloading into boats for shipment to the generating stations."

Earnings of the combined companies for the calendar year 1916 follow:

| | 1916 | 1915 |
|---|---|---|
| Total revenues | $8,237,686 | $7,038,180 |
| Expenses, including taxes and reserve for replacements | 5,046,928 | 4,606.896 |
| Gross income | $3,190,758 | $2,431,284 |
| Reserved for contingencies | 569,175 | ..... |
| | $2,621,583 | $2,431,284 |
| Bond interest and other income deductions | $761,628 | $863,784 |
| Dividends, profit sharing, etc | 1,293,579 | 1,150,216 |
| Surplus for the year | $566,376 | $417,284 |

"The foregoing results," says the report, "have been made possible through strict adherence to the established policy of economical operation of all departments, coupled with energetic efforts toward increasing the number of consumers. Many residential and small commercial users have been connected to the system, including over 1000 unwired houses equipped under the company's partial payment plan. Very satisfactory results have been attained in securing big power business, the contracts signed aggregating upwards of 50,000 hp., including eighteen installations of over 300 hp. each. Sixty-one private plants have been discontinued in favor of the company's service, including one of 4000 hp. It is also gratifying to note that a three-year contract for 4600 hp. has been taken covering the construction of the Fourteenth Street tunnels under the East River, and that material additions have been made to the connected load of existing customers."

## ARBITRATION OF BOSTON STREET-LIGHTING COSTS

### Allocation of Investment in This Class of Service Discussed by City's Witness Under Cross-Examination

Cross-examination of Prof. Harry E. Clifford of Harvard University and the Massachusetts Institute of Technology, expert for the city of Boston in the Boston Edison Company street-lighting rate arbitration, was begun recently before the Massachusetts Gas and Electric Light Commission.

Professor Clifford maintained that an allowance of one-tenth of 1 per cent, or $816, for general office, land and buildings cost is a fairer proportion chargeable to street lighting in Boston proper than the company's allowance of $42,075, or 5.367 per cent. The latter was determined by the ratio of the street lighting to the total energy demand at the L Street generating station. The witness attacked this allocation on the ground that a much smaller percentage should be charged to office expenses in handling the street-lighting business. He maintained that the substation cost should be allocated to street lighting on the basis of space required by equipment.

#### DOES NOT APPROVE MUNICIPAL OWNERSHIP

The witness said, in response to an inquiry by Frederick Manley Ives, counsel for the Edison Company, that he doubted whether the city at the present time could establish a plant which would supply street-lighting service more cheaply than the company should do it; that he did not approve of municipal ownership, and that the following advantages should result from the connection of the Boston street-lighting load with a large system: Reduced investment for a given volume of service, lower generating costs due to the use of much more economical station apparatus for the 65,000-kw. (1914) demand, and greater reliability of service.

Professor Clifford held that these benefits to the city street-lighting service are offset in a measure by the long-hour advantage to the company of the load thus imposed in its effect upon the load factor. For this reason he questioned the wisdom of charging the street-lighting service with particular sums derived from the investment in the remainder of the system. The witness would not concede that the street lighting should bear any of the expense of getting other business which benefits it.

Mr. Ives pointed out that if the city supplied its own street-lighting service substantial office facilities and a good-sized staff would be required. Professor Clifford conceded this, but maintained that very few draftsmen would be needed on account of the repetitive character of street-lighting engineering work.

Professor Clifford allocated 1 per cent of the general service buildings property to street lighting on account of the relative amount of storage space required by poles, globes, lamps and cables. This amounted to $12,089, whereas the company maintained that $78,000 of the general service buildings cost should be charged to street lighting. The witness refused to charge any proportion of the welfare buildings cost into the street-lighting investment.

#### ALLOCATION OF TRANSMISSION LINES

Of the cost of transmission lines connected with Boston substations from which street-lighting service is distributed, the company allocated 4.155 per cent to street lighting. This was the ratio of the series arc and incandescent load on the transmission lines to the total capacity of the latter, as determined by L. L. Elden, electrical superintendent of the company. The total rated capacity of the ten lines thus concerned was 40,000 kw., according to the company.

Professor Clifford contended that for peak rating this capacity could be figured at 60,000 kw., on the basis of raising the voltage on cables now operated at 6900 volts to 13,800 volts and increasing the capacity of the upper voltage lines 20 per cent. The witness contended that all the spare carrying capacity of these cables should be charged against the commercial lighting business, since it is only on the peak that the cables are run at or near their rating, and because the growth of the commercial business is far more rapid than that of the street-lighting load. As the load increases new substations and cables are installed, so that in a specific case the actual load on an individual cable may for a time decrease. Rearrangements of street-lighting circuits may also reduce certain substation loads.

Professor Clifford stated that in his opinion the allocation of substation investment to street lighting based on the capacity of installed apparatus was not fair on account of the advantage possessed by the street-lighting apparatus in greater capacity per unit of occupied floor space as compared with the other equipment in the substation taken in relation to the total area. The space potentially available for commercial apparatus development is greater in square feet per kilowatt, the witness held, but he admitted that the actual capacity of commercial apparatus per square foot of substation floor area is greater than that of the street-lighting equipment. In other words, the intrinsic production capacity of the latter is less in terms of floor area occupied.

In one representative substation the street-lighting apparatus occupies 3.28 sq. ft. per kilowatt of capacity, compared with 0.92 sq. ft. for the commercial apparatus, exclusive of halls and stairways in the former allocation. The witness refused to charge the street-lighting system with any of the space available for equipment expansion in the substations.

---

## PLANS FOR NEW GENERATING STATIONS IN WISCONSIN

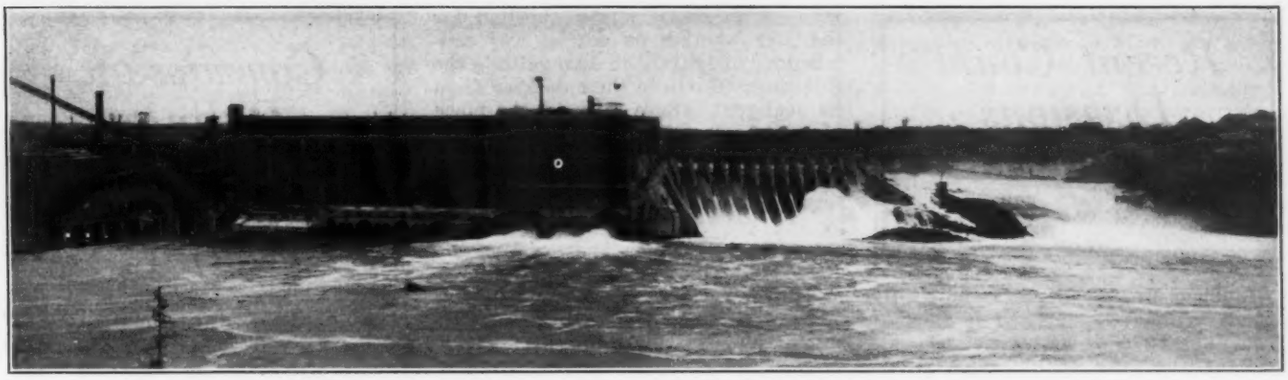
### Milwaukee Electric Railway & Light Company Will Build Station with Initial Rating of 65,000 Kw.—Eastern Wisconsin Company Improvement

The Milwaukee Electric Railway & Light Company will begin the construction during the coming summer of a new generating plant on the shore of Lake Michigan, just south of St. Francis, a Milwaukee suburb. The first installation will contain 65,000 kw., a generating capacity somewhat larger than that of the river-front generating station on Commerce Street, Milwaukee. The new station will contain ultimately 200,000 kw.

The power plant will be connected with the Chicago & Northwestern Railway by a spur track. The right-of-way for the track has been purchased. Work on the railroad construction will begin at once.

Three existing stations of the company in Milwaukee will be continued, as will the purchase of 12,000 kw. of water power now being transmitted from plants on the Wisconsin River.

The erection of a new power house of 5000 kw. or 6000 kw. rating at Sheboygan, Wis., is part of the plan of the Eastern Wisconsin Electric Company, according to Raymond H. Smith, general manager. This plant will be connected with the Fond du Lac and Oshkosh properties of the company by the proposed new transmission line. Plans for construction will be perfected as soon as a survey now under way is completed. An issue of $998,000 bonds, to defray the cost, has been sold.



THE NEW LAURENTIDE POWER COMPANY PLANT IS NOW IN FULL OPERATION

## SHAWINIGAN POWER BUSINESS DEVELOPS RAPIDLY

### Production Now Combined with New Laurentide Plant and Subsidiary Industries Will Accelerate Future Upbuilding

Rapid development of power business is shown in the annual report of the Shawinigan Water & Power Company for the calendar year 1916. The Laurentide Power Company has completed construction work and its plant at Grand'Mère has been put into full operation. The Shawinigan company is operating the power station with economy to both companies. It began to take power from the Laurentide company in 1916 and, with the growth of the business, is using more than was provided in the original contract.

Industries and business growth are mentioned in the report by J. E. Aldred, the president, in part as follows:

"The Canada Carbide Company, Ltd., which manufactures calcium carbide by an electric reduction process, has enjoyed a very satisfactory sale for its product during the year. The company's agents report an active demand for the product in all of the countries where the company is represented. As the result of recent extensions made to the plant, it is anticipated that the output for 1917 will largely exceed that of any period in the company's history.

"The Canadian Electrode Company, Ltd., which was organized to meet the demand for electrodes used in the various electrical industries at Shawinigan Falls, has now completed its plant and is in a position to supply its product. As a large tonnage of these electrodes is consumed annually by electric reduction companies in Shawinigan Falls, the demand for this company's production is assured.

"Early in 1916 a contract was made by the Canadian Electro Products Company, a subsidiary of your company, with the Imperial Munitions Board, for the delivery of certain chemical products required for war purposes. An extensive plant has been constructed at Shawinigan Falls, and this plant is now completed and in operation. This company will be a large addition to the industries at Shawinigan Falls, and it is anticipated that its activities in the production of chemicals will continue after the war demand ceases.

"The total amount of power used at Shawinigan Falls is nearly 100,000 hp. This amount will be increased with the operation of the new industries, and the city may well claim to be one of the great power-using centers in the world.

"The figures of production from your power station and from that of the Laurentide Power Company show a substantial increase over the previous year. The total amount of kilowatt-hours produced during the year from both of these stations was 478,540,000. This amount represents an increase of 19 per cent over the previous year's production of the Shawinigan system.

"Your company, like other large corporations in Canada, has during the progress of the war contributed liberally to the Canadian patriotic fund and other worthy relief funds. The company has also maintained wages to employees who are on active service.

"The new business for 1916 was more than that written in any previous year, and should increase the demand for power on your generating station by 25,000 hp.

"Notwithstanding the fact that almost all commodities, by reason of war conditions, are being marketed at abnormal prices, it has not been the policy of your company to raise its rates, but rather to turn its power resources to the development of industries based upon the natural resources of the country and of such a character as will furnish permanent business and employment after the present conditions have passed."

Gross earnings of the Shawinigan Water & Power Company in 1916 amounted to $2,325,872, an increase of $405,729 over 1915. Expenses were $427,928, leaving a balance of $1,897,944. Net earnings showed a return of 9½ per cent on the average capital employed during the year. Dividends of 7 per cent were paid.

---

## EARNINGS OF THE ELECTRIC STORAGE BATTERY COMPANY

### Operations for 1916, After Payment of Manufacturing Costs and All Other Expenses and Dividends, Leave Good Surplus

The Electric Storage Battery Company of Philadelphia, reporting for the year ended Dec. 31, 1916, shows that $2,069,978 was the amount of gross sales less cost of manufacture and purchases and all expenses incident thereto. Operating expenses, including salaries, commissions, engineering, selling and traveling expenses and rent of branch offices, were $751,182. "Net earnings from sales" were $1,318,796. Other income of $263,257 gave total net earnings of $1,582,053. Dividends were paid of $649,964, leaving a balance of $932,089. The balance sheet surplus as of Dec. 31, 1916, was $2,318,686.

Plant investment was carried in the balance sheet at $2,676,688, and "patents, trademarks and agreements" at $11,000,000. Stocks and bonds in other corporations were listed at $1,658,954. Current assets stood at $5,316,272 and current liabilities at $838,352. In addition to the surplus shown, reserves of $1,231,789 are indicated, divided as follows: For depreciation of capital assets, $828,251; for depreciation of current assets, $187,171; for unfinished contracts and contingencies, $216,367. The annual report is signed by Herbert Lloyd, the president.

# Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public-utility companies.

**Right of Municipality to Issue Utility Bonds Without Submission to Popular Vote.**—There being no restriction in its charter, the town of Belhaven, N. C., was held by the Supreme Court of the State (91 S. E. 369) to have power to issue bonds for the establishment of a system of electric lights, waterworks and sewage without submitting the matter to vote of electors.

**Regulation of Right to Use Street.**—Public service corporations derive their right to use the streets directly from the state, the right of a municipality to control such use being as agent of the state, it was held by the Supreme Court of New York (162 N. Y. S. 770). A corporation can acquire no right to use the streets of a municipality unless it has obtained a charter from the state authorizing such use. It is not within the power of state officials as such to confer any state franchise, but only the legislature in accordance with the constitutional limitations may confer such franchise.

**Burden of Proof.**—In an action against an electric power company for the death of a horse driven into a pool of water at the foot of a pole supporting electric wires, the burden was on the plaintiff to establish the fact that the electrical current which caused the death of the horse escaped from the defendant's equipment, according to the Supreme Court of Wisconsin in Bergeler vs. Waukesha Gas & Electric Company (160 N. W., 1076). Until it was established that the current escaped from the defendant's equipment to the pool, there was no burden on the defendant to establish that the current which killed the horse came from some other point.

**Contributory Negligence Where Company Rules Are Disregarded.**—A telephone company can escape liability as a matter of law for its negligent failure to make the place of work safe for its linemen if it promulgates a rule requiring constant and extraordinary care in all circumstances, and particularly the use of rubber gloves at all times when making repairs to telephone circuits, and if this rule is disregarded by the employee, only in case the inference of negligence from the disregard of such rule is so plain that all fair-minded men would be compelled to that conclusion, it was held by the Court of Appeals of New York (114 N. E. 1043). Where the company had established such rule, but there was evidence that it was never enforced, and that it was not intended to apply to the work a lineman was doing when killed, in performing which it would have been difficult, if not impossible, for him to work with gloves on, it was a question for the jury whether or not he was contributorily negligent in disregarding the rule so as to relieve the employer from its negligent failure to make the place of work safe. Where there was evidence that a telephone company was not enforcing its rules for the protection of employees in places made dangerous by the employer's negligence, it was not necessary to show knowledge of the disregard of the rule by an injured employee to charge the employer with liability. The law that disobedience to the employer's rule in situations inherently dangerous is contributory negligence does not apply where the situation was made dangerous by the employer's negligence.

**Weight of Expert Testimony.**—In the case of Bergen vs. Tulare County Power Company (161 P. 269) the Supreme Court of California held that in an action for death by electrocution testimony of experts as to insufficient grounding, where primary and secondary wires were in direct metallic contact with each other and grounded through the same wire, supported plaintiff's theory that death occurred from faulty and negligent installation and operation by defendant of the system in use at the deceased's pumping station. Where deceased was 50 years old, and evidence showed that he earned $50 a month about half his working time, the other half being spent in conducting his ranch, and he left a widow and minor children, a verdict of $12,500 was not excessive. In such an action where the plaintiff had established the death, while deceased was exercising ordinary care, from an excessive current furnished by the defendant, it then devolved upon the defendant to show that the excessive current was not due to its negligence.

**Condemnation of State Land.**—A law prohibiting the sale of state lands lying within a national forest reservation does not affect the power of a corporation entitled to exercise eminent domain to condemn such lands in accordance with a further law declaring all lands of the state subject to condemnation, saving such lands alone as are not appropriated to some public use, and providing that surveyed and unsurveyed sixteenth and thirty-sixth sections owned by the state or the United States included within a national reserve shall not be condemned as against the United States or the state where the state's title to land so included has not been thereby divested, it was held by the District Court of Appeals of California, and a rehearing was denied by the Supreme Court in the Pacific Power Company vs. State (162 P. 643). In a proceeding by a power company to condemn land excluded by the latter law there was a judgment for the petitioner filed and recorded May 29, 1915, sustaining its right to sue the state, though the final order of condemnation as provided by law had not been entered. The court held, on appeal from the preliminary order or judgment of condemnation, that as the judgment was permitted by the statute in force when it was rendered it would be affirmed.

# Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

**Uniform Meter Deposits in Pennsylvania.**—A meeting of representatives of electric, gas, water and other public utilities was called by the Public Service Commission at Harrisburg on March 23 to arrange equitable plans for the establishment of uniform regulations covering deposits required from consumers and the interest rates paid on such deposits.

**Utilization of Energy Within Control of Company.**—In a decision rendered recently affecting the Pennsylvania Utilities Company and the Lehigh Navigation Electric Company, the Pennsylvania Public Service Commission says: "It is universally recognized that while electricity may be measured before it is converted into light, heat or power and after the measurement may be conveyed by the wires of the consumer, nevertheless the ultimate utilization of the energy is within the control of the public service company and is a determination of its duty to serve."

**Public Utilities Commission for Utah.**—The Utah Legislature has enacted a public utilities law and it has been approved by Governor Bamberger. A public utilities commission is to have jurisdiction over the steam and electric railways, all common carriers, express companies, lighting, power and gas companies, heating companies, telephone and telegraph companies, water corporations including irrigation companies, and warehousemen. A strong attempt was made by some members of the Legislature to have included under the jurisdiction of the commission coal companies, sugar companies, lumber companies and other lines of trade which may be found by the commission to have a virtual monopoly of the business in the State, but this provision was finally defeated.

**Rate of Returns and Cost of Inventory.**—The Illinois Public Utilities Commission, in allowing an increase in water rates in Pekin, decides two interesting questions affecting income and cost of inventory. The fair, reasonable and adequate rate of return upon the valuation was fixed at 7 per cent per annum, "which affords, in addition to the interest rate, a compensation for the inherent risks of the venture and a recognition of efficiency in operating and management." The cost of preparing the inventory of the property is regarded as "an unusual and extraordinary expense sustained by the utility, and the commission accordingly provides for the reimbursement of the company for the moneys thus expended by a reasonable allowance by way of operating expenses for its amortization over a term of five years."

**Engineering College in Manchuria.**—The *Manchuria Daily News* has published a supplement describing the Engineering College at Port Arthur, which is one of the two colleges maintained in South Manchuria by the Japanese. There are six laboratories, of which one is electrical and is equipped with many kinds of apparatus and appliances.

**Kansas Bill Vetoed.**—Governor Capper of Kansas has vetoed the bill under which rates might be announced by utilities and go into effect in thirty days automatically unless the Public Service Commission, with which they were to be filed, entered a denial. Under the present arrangement, the rates must be approved formally by the commission before they go into effect.

**Honor for Milwaukee Employees Returning from Mexico.**—Seventy employees of the Milwaukee Electric Railway & Light Company who, as members of the Wisconsin National Guard, returned recently from duty on the Mexican border were entertained as guests at a banquet on March 24 by the Electric Company Employees' Mutual Benefit Association. Colonel J. A. Watrous, a retired army officer, and Vice-President and General Manager S. B. Way made addresses.

**Civil Service Examination for Navy Department Vacancies.**—Examinations are to be held for not less than six or more than nine vacancies as assistant civil engineer. Appointees are commissioned with the rank of lieutenant (junior grade) with pay and allowance of approximately $2,500 a year. The examination will comprise a preliminary one by mail and a final one in Washington. No candidate over twenty-six years of age on Jan. 1, 1917, will be eligible. The candidate must be a citizen, have a degree from a college or university of recognized standing showing satisfactory completion of an engineering course, and have had not less than eighteen months' practical professional experience since graduation. Further information will be furnished by the Chief of Bureau of Yards and Docks, Navy Department, Washington, D. C.

**Power Survey in Reading, Pa.**—The power sales department of the Metropolitan Electric Company of Reading, Pa., completed recently an industrial survey of the city, which has a population of 125,000. This reveals that there is 24,000 hp. still available to be electrified, and that it would mean an annual income of approximately $500,000 apportioned among 120 different industries. These figures do not take into consideration the growth of each industry in purchasing power, such extensions having been tremendous during the past five years. Nor do they include the contemplated extensions of present customers or the increased income in prospect from several smaller central stations in growing suburbs that buy power from the Metropolitan Electric Company to resell. Another industrial survey of the territories supplied by these smaller central stations is to be made in the near future.

## *Current News and Notes*

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

**Pennsylvania Bill to Prohibit Discontinuance of Electric Service.**—The Pennsylvania Legislature is considering the passage of a bill prohibiting discontinuance of electric, gas, water or other utility service by the utility company while a dispute is in process of adjustment between consumer and company.

**Bond Issue for New Jersey Utility Companies Operating Outside the State.**—A bill has been introduced in the New Jersey Senate to permit public utility companies operating in the State to issue bonds and stocks for expenditures on property outside of the State without requesting permission from the Board of Public Utility Commissioners.

**Medal to Dr. Alexander Graham Bell.**—Before an audience which filled Carnegie Hall, New York, Dr. Alexander Graham Bell, inventor of the telephone, received on March 21 the Civic Forum "medal of honor for distinguished public service." This medal was presented in 1915 to Thomas A. Edison and in 1914 to Major General George W. Goethals.

**Opportunity for Military Training in New York City.**—President Sidney E. Mezes of the College of the City of New York writes to the ELECTRICAL WORLD that young men who desire to get training that will fit them to command troops can do so at that institution. Five hundred young men are now taking a military course during the daytime, consisting of five hours a week of practical training, chiefly drill, and three hours a week of theoretical instruction. Thirty young men in the evening session wish this course to be repeated after business hours, and this will be done if the course obtains an additional enrollment of about sixty. Any young man who resides in New York City and has been graduated from college, or even completed the sophomore year in college, will be admitted to the course and will be under no expense. The college is daily expecting the approval of this work by the War Department and the recognition of the City College battalion as a senior unit of the Reserve Officers' Training Corps, which will involve the detail of an officer by the War Department who will go to the college as professor of military science and tactics and have charge of the course. Those who complete the course satisfactorily, which they probably can do by next September if they elect to take suitable summer camp work, will be eligible for commissions in the Reserve Officers' Corps. Those who are interested can obtain full particulars by writing to Prof. Paul Saurel at the City College.

**Power and Navigation at Niagara.**—Brigadier General William M. Black, chief of engineers, has recommended that the Secretary of War be authorized to investigate the economic possibility of combining the development of power at Niagara with facilities for navigation. A memorandum submitted by him to the Senate Committee on Foreign Relations, indorsed by Secretary Baker, suggests a ship canal.

**Purdue University to Have Engineering Experiment Station.**—Trustees of Purdue University have authorized the organization of an engineering experiment station. Although this development may not include a separate engineering experiment station building at present, it means the organization of industrial and scientific research in the existing laboratories, and the publication of bulletins setting forth the results of such work. It is probable that the plans will include the employment of technical graduates as research fellows to carry out the details of investigations, while the managing board or executive committee will direct such work in the four engineering schools.

**Honor Awards for Safety Work.**—President Arthur Williams of the American Museum of Safety, New York, has made public the contents of the report of the jury of award covering the award of four of the five gold medals which are given annually for noteworthy achievement in safety. The jury has not yet completed its deliberations relative to the award of the E. H. Harriman memorial medals. The awards for 1916 are: The Anthony N. Brady memorial medal, awarded to that American electric railway which for the year has done the most to conserve safety and health of the public and its own employees, is awarded to the Connecticut Company. The silver replica is awarded to S. W. Baldwin, in recognition of his campaign. The bronze replica is awarded to W. J. Flickinger, secretary to the president. Honorable mention goes to the Pacific Electric Railway of Los Angeles, Cal., and the Interstate Public Service Company of Indianapolis, Ind. The *Scientific American* medal, awarded for the most efficient safety device invented within a certain number of years and exhibited at the museum, is awarded to the Pullman Company for originating the "Dean" end frame for passenger cars. The Louis Livingston Seaman medal, awarded for progress and achievement in the promotion of hygiene and the mitigation of occupational diseases, is awarded to the Julius King Optical Company, New York, as a recognition of its scientific investigation of the effect of colored lenses worn by workmen whose eyes are exposed to the blinding glare of metal melting and refining operations, oxyacetylene welding and electric arc welding. The Travelers' Insurance Company's medal for the American employer who has attained great success in protecting the lives and limbs of workers is awarded to the Commonwealth Steel Company, St. Louis, Mo., for its safety system, protective devices, sanitary methods and fellowship work among employees.

**Rejuvenation of the Stark County Electrical League.**—On March 23 a rejuvenation of the Stark County Electrical League was held in the Courtland Hotel, Canton, Ohio.

**Chicago Section, Illuminating Engineering Society.**—James R. Cravath, electrical and illuminating engineer, addressed the Chicago Section of the Illuminating Engineering Society on March 16. The subject was "The Headlight Glare Problem."

**Spring Meeting of Electric Power Club.**—The board of governors of the Electric Power Club has selected the Homestead Hotel, Hot Springs, Va., as the meeting place for the spring convention, June 11, 12, 13 and 14. C. H. Roth, 1410 West Adams Street, Chicago, is secretary.

**Portland (Me.) Electrical Contractors Hold Banquet.**—The retiring manager of the commercial department of the Cumberland County Power & Light Company, G. T. Fisher, and his successor, A. C. Jordan, were the guests of the Electrical Contractors' Association of Portland, Me., at its second annual banquet, held March 13.

**Milwaukee Electrical League.**—In an address at a luncheon of the Milwaukee Electrical League, in the Hotel Gilpatrick, Milwaukee, former Governor F. E. McGovern advocated the establishing of a market commission to look after the relations between consumers and producers, as the Wisconsin Industrial Commission looks after relations between employers and employees.

**Joint Meeting of Engineering Societies of Portland, Ore.**—At a joint meeting of the Portland (Ore.) sections of the A. I. E. E. and N. E. L. A. with the Oregon Society of Engineers, E. A. Beals, district forecaster, U. S. Weather Bureau, Portland, Ore., spoke on "Weather Forecasting." The meeting was in charge of the Oregon Society of Engineers, H. L. Vorse chairman.

**Dielectric Losses in Insulating Materials.**—C. E. Skinner, engineer of the research division of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., addressed a joint meeting of the Franklin Institute and the Philadelphia Section of the American Institute of Electrical Engineers on March 8 on the subject "Dielectric Losses in Insulating Materials."

**Flood Lighting and Street Lighting.**—Flood lighting and street lighting will be discussed at the April meeting of the New York Section of the Illuminating Engineering Society scheduled for the evening of April 12 at the Engineering Societies Building, 29 West Thirty-ninth Street, New York City. Two papers will be presented. R. B. Thompson of the Central Hudson Gas & Electric Company, Newburgh, N. Y., will describe installations of urban and suburban street lighting suitable for small cities. C. A. V. Halvorson of the Lynn (Mass.) works of the General Electric Company will talk on lighting projectors, their development and uses. The dinner preceding the meeting will be held at the Forty-second Street Grill, corner of Madison Avenue.

## *Associations and Societies*

A complete Directory of Electrical Associations is regularly printed in the first issue of each month on the next-to-last text page.

**Pittsburgh Section, Illuminating Engineering Society.**—Prof. A. J. Rowland of Drexel Institute addressed the Pittsburgh Section of the Illuminating Engineering Society on March 30. The subject of his talk was "Elementary Lighting."

**New York Electrical Society.**—On March 28 Rear Admiral Robert E. Peary addressed the New York Electrical Society on "Air Power for the United States," Rear Admiral Bradley A. Fiske spoke on "The Mind of the Navy," and Major-General Leonard Wood spoke on "The Army of the United States."

**Cleveland Section, A. I. E. E.**—Two very instructive meetings of the Cleveland Section of the American Institute of Electrical Engineers were held during February and March. On Feb. 26 H. L. Wallau, electrical engineer of the Cleveland Electric Illuminating Company, contributed a very interesting paper on "The Central Station's Share in Industrial Development." On March 19 R. H. Rogers of the General Electric Company gave an illustrated lecture on "Electric Freight Handling in Terminals."

**Electrical Men Hear Army Needs.**—Major George R. Spalding addressed the Jovian League of Louisville, Ky., on March 12 at the Hotel Henry Watterson, and told the members of the work they could do in an electrical way in the general scheme of preparedness, at the same time promoting their own interests and the interests of the country in times of peace. He told of the work electrical engineers are doing in the European armies, and said that this work is identical with that done in times of peace, except that it is done under greater pressure because of the necessity for haste.

**St. Louis Jovian League Meeting Under Auspices of Wagner Electric Company.**—The March 20 luncheon meeting of the St. Louis Jovian League of Electrical Interests was held under the auspices of the Wagner Electric & Manufacturing Company at the Mercantile Club. Walter Robbins, vice-president of the Wagner Electric, presided. V. A. Finn, consulting engineer of the company, who has spent twenty-nine seasons climbing and exploring the Alps, delivered an illustrated lecture entitled "Experiences in Climbing Above the Skyline." At a meeting of the executive committee on the evening of March 20 a recommendation to apply for a Jovian charter was approved. Accordingly a committee was appointed to draft a new charter. After it is completed the proposal will be submitted to the members for approval.

**Beaver County Light Company Section of the N. E. L. A.**—H. H. Swaney was the principal speaker at a banquet held under the auspices of the Beaver County Light Company Section of the N. E. L. A. on March 7.

**Schenectady Meeting of the A. I. E. E.**—The three hundred and thirty-first meeting of the American Institute of Electrical Engineers will be held in Schenectady, N. Y., April 13. The Institute headquarters during the meeting will be in the Edison Club, 60 Washington Avenue. The meeting will be under the auspices of the standards committee. A paper on "Temperature Corrections" will be presented by V. M. Montsinger of the General Electric Company. Four other papers bearing on allied subjects will be presented for discussion. They are as follows: "Temperature Distribution in Electrical Machinery," by B. G. Lamme; "Rational Temperature Guarantees for Large Alternating-Current Generators," by F. D. Newbury; "Internal Temperatures of Alternating-Current Generators," by Ralph Kelly, and "Electrical Machinery Tests and Specifications Based on Modern Standards," by H. M. Hobart.

**Public Relations Discussed at Banquet Concluding O. E. L. A. Meeting.**—More than 400 persons were present at a banquet which closed the convention of the committee on new-business co-operation of the Ohio Electric Light Association. Charles S. Hall, president of the Dayton Jovian League, presided as chairman, and D. L. Gaskill, president of the Greenville Electric Light & Power Company, acted as toastmaster. After-dinner speeches were made by H. M. Waite, city manager of Dayton; W. W. Freeman, president of the Union Gas & Electric Company, Cincinnati; C. F. Kettering, vice-president of the Domestic Engineering Company, and F. R. Coates, president of the Toledo Railway & Light Company. W. W. Freeman, speaking on "The Relation of the Public Utilities to the Public," said the relation should be for the benefit of mutual interests. For example, the Dayton Power & Light Company is not primarily to make dollars for the stockholders, but rather to give the people the service they require. It is to the interest of the public that a public utility be prosperous, for if it be otherwise, it cannot give the character of service a community requires. At the same time, he maintained, public utility companies should have an incentive to render the most efficient and valuable public service. C. F. Kettering, speaking on "Future Applications of Electricity," said among other things that future applications will depend upon what the public demand. The importance of courtesy in telephone communication was emphasized by F. R. Coates, who spoke on "The Public Be Pleased." Conditions are changing and the public has begun to view public utilities in a different light. The change was attributed to the manner in which public utilities are treating the public. The speaker quoted ten commandments by which, he maintained, every public utility should be governed.

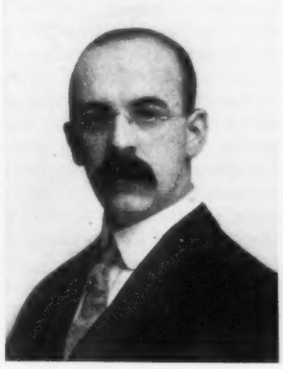
# *Men of the Industry*

Changes in Personnel and Position—Biographical Notes

**George T. Fisher** has resigned from his position as commercial manager of the Cumberland County Power & Light Company, Portland, Me., to enter business in New York City.

**C. W. Forbrich,** Western manager of the *Electrical Review and Western Electrician* since 1908, has resigned his position to enter the advertising field on his own account, a plan which he has been maturing for some time. Mr. Forbrich, in point of service, is probably the oldest electrical newspaper advertising man, having been in the business since March, 1888. He began as office boy with the *Western Electrician*, and was secretary and treasurer of that publication for a number of years prior to its consolidation with the *Electrical Review* in 1908. Together with J. H. Burton, he has formed the Forbrich-Burton Advertising Service, Inc., Monadnock Block, Chicago, the object of which will be to give selling co-operation, to place trade paper and magazine advertising, and to prepare advertising literature.

**W. E. Robertson** of Buffalo, N. Y., has been elected chairman of the Atlantic Division of the Electric Supply Jobbers' Association. Mr. Robertson was born in South Carolina in 1874. He entered the electrical business in 1898 with his brother, James D. Robertson, and in the following year became a partner in the firm of Robertson Electric Construction Company. While engaged in business he found time to study law, being graduated from the Buffalo Law School in 1900 with the degree of Bachelor of Laws. He remained, however, in the electrical industry, and is now president of the Republic Electric Company, general manager of the Robertson-Cataract Electric Company, and vice-president and general manager of the Robertson Electric Construction Company. He has always been active in electrical association work, and was the sixth Jupiter of the Jovian Order. In addition, he is vice-president of the



W. E. ROBERTSON

Society for Electrical Development, of which he was one of the founders. Mr. Robertson has also taken a prominent part in the civic affairs of the city of Buffalo, having served for a time as the president of the Buffalo Chamber of Commerce.

**F. H. Mugg,** industrial engineer with the Enid (Okla.) Electric & Gas Company, has been promoted to a similar position with the San Diego (Cal.) Consolidated Gas & Electric Company.

**H. L. Draper,** for some time assistant commercial manager of the Birmingham (Ala.) Railway, Light & Power Company, has been appointed commercial manager to succeed H. M. Kohn, who resigned to enter business for himself.

**A. V. S. Lindsley,** formerly with the Syracuse Lighting Company, is now connected with the Northern Indiana Gas & Electric Company at the main office, Hammond, Ind. Both companies are operated by the United Gas Improvement Company of Philadelphia.

**E. R. Treverton,** for the past three years a member of the editorial staff of the *Lighting Journal*, recently amalgamated with the ELECTRICAL WORLD and ELECTRICAL MERCHANDISING, has become connected with Holophone Glass Company, Inc., New York City. Mr. Treverton was graduated from Lehigh University in 1907. After getting a fundamental training in central station work with the cadet school in the Doherty organization of Denver, he joined the engineering department of the Westinghouse Electric & Manufacturing Company at East Pittsburgh, designing and engineering for its various shops the first really scientific industrial lighting in this country. From 1910 for three years he was with the illuminating engineering department of the Westinghouse Lamp Company, later becoming chief engineer of that department.

**E. Burt Fenton,** for the last two years publicity manager of W. S. Barstow & Company, Inc., has severed his connection with that organization. Mr. Fenton became connected with the Barstow interests through the Sandusky (O.) Gas & Electric Company, for which he conducted the publicity work of two municipal ownership campaigns, and prepared a series of good-will advertising articles which attracted wide attention. He is the author of "Snuggling Up to John Smith," dealing with public relations in general, and "The Missing Link," dealing with the question of municipal ownership, both of which were read before the annual conventions of the Ohio Electric Light Association, one in 1916 and the other in 1915. They attracted considerable favorable attention from public utility operators throughout the country. Mr. Fenton was formerly connected with newspapers in Pittsburgh, Pa., Columbus, Toledo and Zanesville, Ohio, and was for some years editor of the Sandusky Star-Journal.

**W. S. Mendenhall,** commercial manager of the Grays Harbor Railway & Light Company, Aberdeen, Wash., has resigned his position to go into partnership with the Welch-Richards Printing & Bookbinding Company of Aberdeen. Mr. Mendenhall has been connected with the Grays Harbor Company for seven and one-half years, having begun as stock clerk and worked his way up to be commercial manager.

**Sydney O. Swenson** has resigned as a member of the engineering offices of Putnam A. Bates, consulting engineer, New York. Mr. Swenson was assistant electrical engineer of the Detroit River tunnel electrification from 1907 to 1911 and from 1911 to 1916 was electrical engineer of the Kansas City Terminal Railway Company, in charge of all electrical work in connection with the terminal improvements made at Kansas City. Before that he was engaged for two and one-half years on the New York terminal electrification of the New York Central & Hudson River Railroad Company. From 1899, when he was graduated as electrical engineer from the University of Illinois, to 1905 he was a member of the engineering department of the Commonwealth Edison Company, Chicago.

**Fred A. Otto,** who has resigned his position as superintendent of the electrical department of the St. Paul (Minn.) Gas Light Company and general superintendent of the St. Croix Power Company to become general manager of the Minnesota Gas & Electric Company at Albert Lea, Minn., is president-elect of the Minnesota Electrical Association. Mr. Otto was graduated from the University of Minnesota with the class of 1904, and subsequent to that time took up apprenticeship work with the Westinghouse Electric & Manufacturing Company at East Pittsburgh, Pa. Later he returned to St. Paul, where he has been for thirteen years continuously employed by

FRED A. OTTO

the St. Paul Gas Light Company. For the last four years he has been secretary of the Minnesota Electrical Association. He is a member of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers and the N. E. L. A.

# REVIEW OF TRADE AND MARKET CONDITIONS

*News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods*

## EFFECT OF WAR ON MARKET FOR ELECTRICAL GOODS

### Small Possibility of Any Decrease in Manufacturing Activity Provided Sufficient Labor Can Be Procured

A wide divergence of opinion exists concerning the probable effect of war on the electrical manufacturing industry of the United States. The opinions, however, are frankly admitted to be but guesses, and are based on belief and supposition rather than fact. One thing, however, seems certain, and that one thing is that the factories will show no signs of decreased activity for some time, provided always, of course, that a sufficient amount of labor can be had. Factories are now working at capacity, and sufficient unfilled orders are on the books to provide capacity activity for practically the remainder of the year without receiving another order. However, the government, in the event of war, will be in the market for quantities of electrical supplies, and will add to the already congested condition of the factories. Government orders, of course, will be given preference, and will be rushed through the shops with all possible speed. Other consumers can expect, therefore, longer deliveries in proportion to the amount of factory space that will be taken for government manufactures. There are, however, many new factories, shops, and additions to present production facilities under construction, the work on which will probably be rushed to a more speedy completion should the congestion assume very large proportions.

A feeling exists that the country has practically reached its electrically equipped peak, and that any great war activity on the part of the United States would not necessarily mean any great added demand for motors and appurtenances. There is a feeling that munition factories, being about through with European contracts, will not need additional equipment to take on work for the home government, that other factories which have been fed by the munition factories are in the same position, and that the motors and generators now in the process of manufacture, together with those in the hands of second-hand dealers, will be sufficient to handle the load placed on them. There is no doubt that factories are equipped sufficiently to handle the demands of the government, but it must not be lost sight of that this demand, if it comes, will be superimposed upon a demand already in excess of manufacturing capacity. Consequently there seems some ground for the belief that an added amount of factory space will be built, and that this will require equipment. Because the government will have first call on production equipment is no reason to believe that other customers will have to wait indefinitely.

Wire and cable manufacturers have sufficient orders on hand to keep them going for some time, but there is a feeling that in the event of war the government contracts might be offset by a decrease in new construction and wiring. There is excellent ground for belief that this might be the result as regards dwelling, church, hotel, theater, office building and such construction, but utility, municipal, mine and industrial construction is much less apt to be put off—in the case of the utilities because of necessity owing to increasing load, in that of the municipalities because they are less affected by such conditions, and in that of the other kinds of construction for reasons given above.

In addition to the manufacture of electrical goods it must be remembered that electrical manufacturers are equipped to handle munitions contracts. Most of the large manufacturers have been engaged in turning out great quantities of shells and guns for Great Britain, France and Russia. It is, therefore, practically certain that electrical manufacturers will be called upon to furnish the government with shells as soon as plans are definitely made. In fact, it is even now reported that certain large contracts for shells have already been let to be fabricated in some of the more important electrical factories.

There is considerable apprehension regarding labor in the event of active war. The labor market, while easier than it was some months ago, still shows a deficit in the number of men available as compared with those needed. Planting time is coming on and will take men from the cities. Thus, before recruiting begins, industry finds itself short of help, with an added demand staring it in the face, for the more the men that go into the army the greater will be the government's needs. Of course, war will cause some readjustments. Many who are now employed will find that in the event of war their jobs will cease. But in the great factories and mills are men trained to their jobs, and if these industries are to turn out a maximum of product some provision will undoubtedly have to be made whereby labor in sufficient quantity and of satisfactory quality shall be furnished. The government, it is known, has made some arrangements in this direction. Should a large army leave the country there is no doubt that women will enter industries in greater numbers.

During the past two weeks there has been a perceptible let-up in trade. Contracts are being deferred, although not in large quantities. For the most part, however, the events preliminary to a declaration of war have had but little effect on the market. It is even probable that some of the noticed slowing up was due to other than war causes, possibly to seasonal conditions.

---

## SHIPBUILDING USES QUANTITIES OF ELECTRICAL GOODS

### Government Program for Construction of Warships Will Call for a Large Volume of Motors, Generators, Batteries, Etc.

At no other time in the history of the United States has there been so much activity in shipbuilding as there is at the present time. All along the Atlantic Coast shipyards are busy and have more work than can be handled. In the Northwest the building of ships for Pacific service has been so great as to change the entire complexion of the general business situation of that section. Prior to this activity in the shipyards the Northwest was suffering a general business and financial depression. Owing to the tremendous increase, however, in shipbuilding, the lumber, metal and labor markets have strengthened, and now the Northwest is comparatively prosperous.

The effect of this activity has been of no little consequence to the electrical trade. It has meant the purchase of large quantities of electrical supplies of practically every kind. Wire, cable, fittings, lamps, sockets, wireless apparatus, motors, batteries, generators and other electrical equipment are finding their way into the new vessels in quantities.

Of greatest importance probably in the matter of money spent are the new war vessels now being built or contracted for by the government. The use of motors for hoisting, refrigeration and in some cases for propulsion; the use of electricity for cooking; the use of storage batteries particularly for submarines, of which large quantities are being and will be built—these, together with all the necessary apparatus and appliances to go with them, constitute one of the large single sources for the sale of electrical supplies.

The naval program of the government, which calls for the building of many more ships in a short time, will un-

doubtedly mean an additional demand upon electrical manufacturers in this country for equipment. Manufacturers are now working at capacity, but the government contracts will of course have to take precedence over private contracts no matter for how long a time they may have been on the books of the producers.

## EXPORTS OF ELECTRICAL GOODS ARE FALLING OFF

### German Submarine Activity Holds Up Sailing of a Large Number of Ships, Causing Freight Embargoes

While no figures are yet available, it is generally understood that the exports of electrical goods since the first of February when the new U-boat order went into effect have been considerably less than during the previous months. Large quantities of material in this country await shipment abroad, but through fear of submarines vessels have been held up and a much smaller volume of goods has left the ports of the United States. The European trade, of course, is the only one affected by the submarine activity. Since the war began, however, Europe—particularly England—has been one of the large markets for American electrical goods.

The congestion of goods for export of every description at Atlantic ports has grown to such proportions that the railroads have had to place embargoes on goods coming through from the West for export. This has caused large quantities of goods to be held up at the shops although ready for shipment.

Delays are now so frequent and of such long duration that some American manufacturers have found it necessary to make a change in their method of billing foreign customers. Where formerly customers were billed f.a.s. New York, cash on receipt of shipping papers, they are now billed f.o.b. factory, cash on receipt of bill of lading. In this way the manufacturer places on the customer the burden of financing the goods after they are manufactured.

## THE INTERNATIONAL COMMERCIAL OUTLOOK

### Statistics Show Little Likelihood of Industrial War After Peace Has Been Declared—Loss of Ships of Little Consequence

To the electrical manufacturer in the United States the commercial outlook for international trade following the war has a double significance—first, in the market for electrical goods abroad, and second, in the market in this country for electrical goods brought about by foreign trade. American exports have been larger since the war than they ever were before the war, but it is equally true that no small part of the exports from the United States was purchased for either direct or indirect war purposes. To neutral countries, however, there is unmistakable evidence that the trade with the United States has grown considerably. Furthermore, it is undoubtedly true that the exports of goods having no connection with the war to Europe have also increased. The question has naturally arisen, therefore, as to whether American manufacturers will maintain the position in the foreign market now held and also in what condition the foreign market will be, first, to buy and, second, to produce goods.

That Europe will need goods there is no doubt. Goods will be needed not only for the rehabilitation of devastated areas but also for the regular commercial peaceful pursuits. There seems little reason to believe that nations now at war with each other will prolong the struggle after peace has been declared into an industrial war. Statistics show that after all great struggles trade between the warring nations was greater than before the struggle. Furthermore, there is no good reason to believe that European buyers are going to buy anywhere but in the most favorable markets. Price, quality, delivery, etc., are the factors which will influence trade after the war just as they did before the war. It is evident, therefore, that there is little occasion for American manufacturers to believe that after the war German markets will be closed to English and French goods and that English, French and Russian markets will be closed to German and Austrian goods.

Furthermore, statistics show that so far as labor is concerned Europe is in a better position to-day, and will be after the war, to make progress industrially than before the war. The net increase in male population of the countries now at war is greater than the number of males killed or maimed to an extent to be unfit for industrialism. This is in addition to the number of women who will undoubtedly seek to retain employment in industrial establishments after the war and in addition to the great developments in manufacture which have been brought about in Europe since the war began.

There is little likelihood that the destruction of vessels will in any way curtail foreign trade after the war is over, for according to the latest estimate only about 10 per cent of the world's tonnage has been destroyed so far, while the production of new ships in the meantime has been fully half as much as the tonnage of those destroyed, so that the net loss it may be assumed is not more than 5 per cent. With this loss distributed all over the world, it is not likely to prove of much account in post-war trade.

## THE COPPER MARKET MUCH EASIER IN TONE

### Weather Conditions Accountable for Much Freer Offering at Slightly Lower Prices Than Last Week

During the last week the tone of the copper market has become much easier, and offerings are being made much more freely. The warm spring weather has probably been the influencing factor. Many large buyers are now willing to release a part of their stocks with the feeling that deliveries are getting better, and that better weather will bring better transportation facilities and better mining conditions. The stocks now being offered are those that were kept for emergency or reserve purposes.

Prices are down a cent or so, but should any active buying develop they will probably take a sharp rise. The sale by producers of 45,000,000 lb. of copper to the government at around 16 2/3 cents is not expected to have much, if any, effect on the market because of the small amount in proportion to the total tonnage produced. There is, however, a distinct feeling that copper producers will exert whatever influence they have to prevent any great rise in the price of copper, because of the scandal that would undoubtedly arise.

Prices quoted on Tuesday of this week for electrolytic were as follows: March, 34.75 cents; April, 34.5 cents; second quarter, 34 cents; third quarter, 30.5 cents; and fourth quarter, 29.5 cents.

NEW YORK METAL MARKET PRICES

| | March 20 Selling Prices Bid | March 20 Selling Prices Asked | March 27 Selling Prices Bid | March 27 Selling Prices Asked |
|---|---|---|---|---|
| Copper | £ s d | | £ s d | |
| London, standard spot | 136 0 0 | | 136 0 0 | |
| Prime Lake | 35.00 to 35.50† | | 35.00 to 35.50† | |
| Electrolytic | 35.50 to 36.00† | | 34.50 to 35.00† | |
| Casting | 31.25 to 31.75† | | 31.25 to 31.50† | |
| Copper wire base | 40.00 to 42.00† | | 39.00 to 41.00† | |
| Lead | 9 00 | | 9.00 | |
| Nickel | 50.00 | | 50.00 | |
| Sheet zinc, f.o.b. smelter | 21.00 | | 21.00 | |
| Spelter, spot | 10.55 to 10.80 | | 10.80 to 10.92½ | |
| Tin, straits | 55.50 | | 56.00 | |
| Aluminum, 98 to 99 per cent | 54.00 to 56.00 | | 55.00 to 57.00 | |
| **OLD METALS** | | | | |
| Heavy copper and wire | 28.50 to 29.50† | | 29.00 to 30.00 | |
| Brass, heavy | 17.50 to 18.00† | | 17.00 to 17.50 | |
| Brass, light | 14.25 to 14.50† | | 13.00 to 13.50 | |
| Lead, heavy | 7.75 to 8.00† | | 7.25 to 7.50 | |
| Zinc, scrap | 7.50 to 7.75† | | 7.50 to 7.75 | |

†Nominal.

# NEW APPARATUS AND APPLIANCES

*A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field*

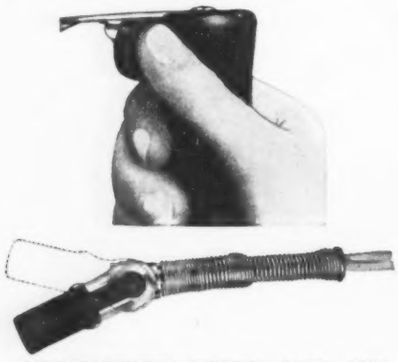
## Electric Hand Lantern

An alkaline storage battery is employed to operate the electric hand lantern shown in the accompanying illustration. The bulb support is designed so that if the lens is broken the lamp bulb will be knocked off its supports and the circuit broken before the filament can be exposed, thus preventing an explosion in case the lamp is being used where inflammable gases exist. The glass which is used is very thick and is annealed so that it cannot be easily broken. Enough electrolyte can be prepared from 1 lb. of the battery compound to operate one lantern constantly for four months. Soft rubber cover gaskets are used, which, while permitting the gases to escape, prevent the leakage of solution, should the lantern be overturned. The lamp is made by the Portable Electric Safety Light Company, 10 Johnson Street, Newark, N. J.

PORTABLE ELECTRIC SAFETY LANTERN

## Plug for Electric Iron

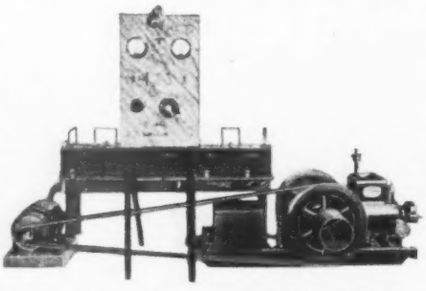
A hinged cord-protector switch plug which, the manufacturer claims, prevents cord breakage has been developed by the Hotpoint Electric Heating Company of Ontario, Cal. The cord passes through a double spiral spring, the end of which is securely fastened to a slide hinge joint provided on the upper part of a metal plug cap. The spiral spring supports the cord and prevents sharp bends or kinks which usually occur in the cord near the plug. A composition plug bar is provided as an anchor for the cord. Slotted contact springs are used to give four-point contact. Another improvement which this company announces is the thumb rest. Placing the thumb on this rest at intervals during ironing relieves the wrist and makes ironing easier, it is claimed.



CORD-PROTECTOR SWITCH PLUG AND THUMB-REST FOR IRONS

## Electric Lighting Plant

The Main Electric Manufacturing Company of Pittsburgh, Pa., has brought out a new 25-lamp electric lighting outfit which includes a gasoline-engine operated flywheel-type generator rated at 40 volts and 15 amp., a thick-plate battery rated at 40 amp.-hr. and a switchboard equipped with a voltmeter, ammeter, automatic cut-out, field-regulating rheostat, pilot lamp, etc. Both magneto and battery ignition are furnished for the engine. Extra heavy flywheels with crown faces are employed to permit using belt drive. One feature, to which attention is called by the manufacturer, is the use of an inclosed intake valve which permits this type of engine to pass fire underwriters' inspection.



24-LAMP ELECTRIC LIGHTING OUTFIT

## Interchangeable Mogul Sockets

The Arrow Electric Company has developed a complete line of porcelain mogul sockets, made up of interchangeable units, including five bodies and nine caps. All screw hole spacings are the same (1 5/16 in.), and all attaching screws are the same length and size (11/16 by 10/32 in.). The attaching screws have pointed ends, which facilitate assembling. The fourteen interchangeable parts make possible forty-five different combinations, which cover all the present types assembled and a number of additional types. With these arrangements it is possible to meet practically any requirement made in actual practice, and the number of pieces required in stock has been reduced from three to one and the investment from seven to one. The parts are packed with five bodies and ten caps to the carton. Standard packages contain fifty units in all cases.

FIVE MOGUL SOCKET BODIES INTERCHANGEABLE WITH NINE CAPS

## Low-Voltage Gas-Filled Lamps

The Lux Manufacturing Company of Hoboken, N. J., has recently developed 27 to 32-volt gas-filled lamps, which it is manufacturing in 25, 50, 75, 100, 150 and 200-watt sizes. The maker states that tests show these lamps are very sturdy and have high efficiency. It is said that a number of railroads are considering equipping coaches with this type of lamp.

## Lightning Arresters for Transmission Lines

Two lightning arresters of the Burke series horn-gap type using a triangle choke coil have been placed on the market by the Railway & Industrial Engineering Company of Pittsburgh, Pa. The arrester shown in the accompanying illustration is intended for use on transmission systems where large-magnitude surges occur. A reactance coil connected in series with a Koppat resistance is provided in the ground circuit. An auxiliary gap shunts both

ARRESTER FOR USE ON TRANSMISSION SYSTEMS WHERE HIGH-CAPACITY SURGES ARE EXPERIENCED

the reactance coil and the resistance, thus giving a straight path to ground for surges that cannot be discharged quickly enough through the reactance coil and resistance. The reactance coil aids in limiting the rush of power to ground or between phases in case two or more arresters discharge at the same time, and also relieves the resistance of the heavy duty by smoothing out the surge before it reaches the resistance. It is claimed by the manufacturers that abnormal surges can be instantly and effectively relieved from the line without causing any noticeable disturbance of the transmission system.

The other arrester which was recently developed contains a resistance that is shunted by an auxiliary horn gap connected direct to ground. When a discharge occurs across the auxiliary gap, the arc breaks almost instantly, thus inserting the resistance in the ground circuit in series with the power arc which is broken by the main horn gap.

## Outlet-Box Receptacle

Harvey Hubbell, Inc., of Bridgeport, Conn., has redesigned its No. 6103 outlet-box receptacle, incorporating a subbase which is intended to protect the wires from contact with the box or fitting. Since the wire passages are free from sharp edges or corners, wear on the wire covering and the possibility of accidental short-circuits through the contact of exposed wire with the fitting are minimized. The receptacle is designed for cover mounting, the cover being securely attached between the upper and center porcelain by a single center screw. A leather gasket is furnished between the two pieces of porcelain to allow for variations in separation and assure the rigidity of the cover. The slots are of the standard 1-T type with which all Hubbell 10-amp. caps and lamp receptacles are interchangeable.

## Immersion Heater

The heating unit of the immersion heater shown in the accompanying illustration is permanently embedded in cement under heavy pressure, the use of mica being entirely avoided. The heater is neat in appearance, has a round 3-in. base and weighs 11 oz. with plug and

DISK-BASE IMMERSION HEATER

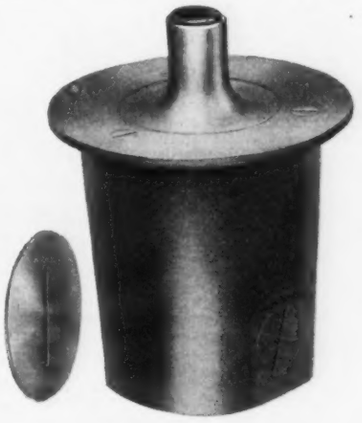
cord. The handle is always cool, it is claimed. Each heater is equipped with a 6-ft. detachable cord and two-piece connection plug. The Sterling Corporation of Cleveland, Ohio, is the manufacturer of this heater.

## Washing and Wringing Machines

The Brokaw-Eden Manufacturing Company of Alton, Ill., has developed an electric washing and wringing machine which has the following features: The machine has an automatic stop button, which when pressed stops the cylinder in the correct position for opening. A slight pull on the button starts the cylinder. Every moving part of the machine is covered, thereby preventing accidents and making it impossible for clothing to catch on any moving parts. When the cylinder doors are open they engage with the sides of the tub in such a manner as to prevent the clothes from dropping down under the cylinder. Another feature of construction is a window with a cross bar to indicate the proper water level. The machine also has a wringer control lever, sanitary all-zinc cylinder that reverses automatically, and a quick-acting drain cock. A 1/6 hp. Robbins & Meyers motor with automatic release is used.

## Non-Adjustable Floor Box

Shown herewith is a non-adjustable floor box which the manufacturer claims can be installed, inspected and repaired with very little labor expense.

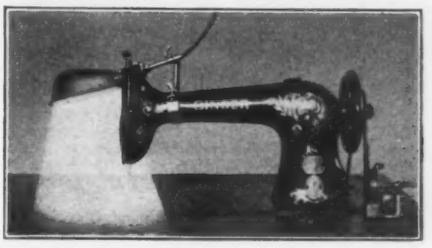


NON-ADJUSTABLE FLOOR BOX WITH RECEPTACLE AND PLUG

The box is made by W. R. Ostrander & Company of New York City. With this box it is possible to make a neat job, since it is only necessary to slit the seam of the carpet or rug to receive nozzle of the box. When the box is to be set in the floor, a hole can be counterbored therein with an ordinary expansion bit to accommodate the floor plate and another smaller hole bored through the flooring to receive the body of the box. By inserting the box with the floor plate removed screws can be driven horizontally through the iron body of the box into the surrounding boards. Thus any strains on the box will be carried by the body and not by the floor plate. The box is 2⅞ in. in diameter, has four outlets, and is drilled and tapped for ½-in. conduit. There are two outlets at the side and two at the bottom.

## Sewing-Machine Lamp

Adjustable lighting fixtures that permit applying light directly on work which is being done on sewing machines have been brought out by the Keith Manufacturing Company of Clinton,

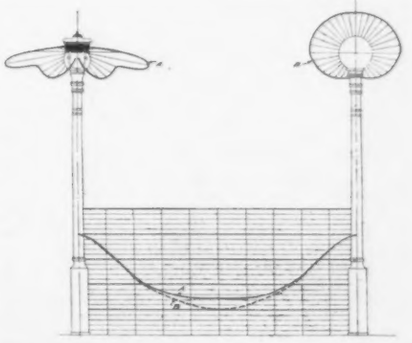


LIGHTING FIXTURE USED ON SEWING MACHINE

N. Y. The lamp can be placed instantly in any desired position or as quickly moved out of the way. It is claimed that by the use of these fixtures the efficiency of the operator can be increased and that the eyesight troubles which are so often caused by poor lighting can be very greatly minimized.

## Street-Lighting Units

An artistic street-lighting fixture which contains a prismatic reflector for collecting the rays which extend above a horizontal plane through the lamp and re-directing them slightly downward to illuminate the street surfaces has been developed by the General Electric Company of Schenectady, N. Y. The poles should be arranged alternately on opposite sides of the street. The light from each unit is thrown toward the next, so that there is increased illumination of the roadway and sidewalk. In the accompanying illustration are curves showing the average amount of light distributed at any point between light sources. For comparison data were plotted for a series of the new-type units and an equal number of the old round-globe type. The units of light and distance are represented by horizontal and vertical lines respectively. The former read upward. It



ILLUMINATION AT DIFFERENT DISTANCES

may be noticed that the solid line representing the lighting power of the new units is above the other almost throughout its length, thus indicating the greater illumination at various distances.

## Trade Notes

THE ALLMUR MANUFACTURING COMPANY has changed its address from Janesville, Wis., to Marion, Ind.

FERDINAND W. ROEBLING, secretary and treasurer of John A. Roebling's Sons Company, Trenton, N. J., died March 16.

PETER COOPER HEWITT has removed from Madison Square Garden Tower, Twenty-sixth Street, to 18 East Thirty-third Street, New York City.

THE JEFFERSON ELECTRIC MANUFACTURING COMPANY of Chicago announces that Thomas C. Hawkins is affiliated with its sales force.

THE TERRY STEAM TURBINE COMPANY, Hartford, Conn., announces that L. S. Shaw is now handling the company's interests in Detroit, Mich., and that Victor L. Sanderson is now connected with its Philadelphia office.

THE DIXIE DEVICE CORPORATION of 120 Liberty Street, New York City, has purchased the entire vibrator business of the Rubes Electric Devices, Brooklyn, N. Y., and will continue to market the same electro-magnetic vibrator.

THE CRESCENT INSULATED WIRE & CABLE COMPANY, Trenton, N. J., with headquarters at 240 West Fifty-fifth Street, New York, has increased its capital from $250,000 to $1,000,000 for expansion. General C. Edward Murray is president and E. T. Phillips secretary.

THE METROPOLITAN ELECTRICAL SUPPLY COMPANY, now at 76 West Thirty-sixth Street, New York City, announces that about April 1 it will occupy its new quarters at 124-36 West Thirty-sixth Street. The company has built special showrooms for the display of lighting fixtures.

EDWIN G. HATCH, consulting engineer, New York City, is arranging to have a large quantity of nickel-steel turbine buckets manufactured in this country for the South African plant of the Victoria Falls & Transvaal Power Company, Ltd. These buckets were originally supplied by the Allgemeine Elektricitäts Gesellschaft of Germany.

BARBER-JAMES-DWINNELL ELECTRIC & MANUFACTURING COMPANY will maintain offices both at Topeka, Kan., where the company's new factory is situated, and at the old address, 600 East Fifteenth Street, Kansas City, Mo. Sales force will be kept at Kansas City and a stock of apparatus and supplies carried at that place.

THE WESTINGHOUSE LAMP COMPANY has closed its option on a factory site in Milwaukee, Wis., which it has occupied under lease from Nathan Pereles, Jr., since 1914. The plant has an output of around 1,000,000 lamps per month. Four hundred men are employed. The company, it is understood, is planning the erection of a big addition.

THE COMBUSTION ENGINEERING CORPORATION announces that Walter H. Wood, mechanical engineer, has become associated with its staff of combustion experts as engineer of tests and research. G. E. Learnard, vice-president and general manager of the company, states that over 1,500,000 hp. is now being developed with its type "E" stokers, in addition to which considerably over 500,000 hp. of its Coxe stokers for anthracite coal is in use.

THE FRANK H. STEWART ELECTRIC COMPANY, Philadelphia, Pa., has made some changes in its board of directors. The directors now are Frank H. Stewart, president; W. Burnett Stewart, vice-president; Frank E. Hacker, secretary; Lewis M. Creighton, treasurer; William T. Walker, general manager; Samuel Bordman, sales manager; J. Bayard Kelley, George H. Carnall, C. Bertran Vanderslice, Jr., Elmer Barton, Raymond J. Courtenay and Edward D. Saint.

H. W. EVES, who for the last two years has been assistant manager of the Chicago office of the Hamilton-Beach Manufacturing Company and secretary of the Consolidated Manufacturers' Company, has resigned to become Chicago manager of the Arnold Electric Company of Racine, Wis. In his new quarters at 923 Marquette Building Mr. Eves will also handle the account of the Electric Controller Company of Indianapolis and the Sterling Corporation of Cleveland.

W. S. RUGG, formerly district manager of the New York office of the Westinghouse Electric & Manufacturing Company, has been appointed successor to Charles S. Cook as manager of the railway department of the company, with headquarters at East Pittsburgh, Pa. E. D. Kilburn, manager of the power department of the company's New York office, succeeds Mr. Rugg, and E. P. Dillon, formerly assistant to the manager of the railway and lighting department at East Pittsburgh, succeeds Mr. Kilburn as manager of the power department of the New York office.

THE ASTRA ELECTRIC NOVELTY WORKS, Inc., 45 East Seventeenth Street, New York City, have been formed to manufacture dry batteries for flashlights, for disposal both in America and in foreign countries. The war has caused a great demand for these batteries. The factory at 152-156 Wooster Street, New York, is equipped with modern machinery and is prepared to turn out goods at short notice. The laboratory connected with the factory, the company states, has every up-to-date device for testing and experimental purposes and orders for any quantity can be handled for early delivery. Territorial agencies are being allotted.

## New Incorporations

THE CARL ELECTRIC CONSTRUCTION COMPANY of Akron, Ohio, has been incorporated with a capital stock of $10,000 by George E. Carle.

THE ELECTRIC EQUIPMENT COMPANY of Nashville, Tenn., has been incorporated with a capital stock of $10,000 by J. T. Shannon, J. H. Conn and others.

THE MANCHESTER (TENN.) ELECTRIC LIGHT & POWER COMPANY has been chartered with a capital stock of $5,000 by T. H. Webb, J. B. Wall and others.

WALKER TOWNSHIP ELECTRIC COMPANY of Bellefonte, Pa., has been granted a charter, with a capital stock of $5,000, to operate in Juniata County. A. J. Musser of Clearfield, Pa., is treasurer.

THE MILFORD TOWNSHIP ELECTRIC COMPANY of Bellefonte, Pa., has been chartered, with a capital stock of $5,000, to operate in Juniata County. A. J. Musser of Clearfield, Pa., is treasurer.

THE THOMPSONTOWN ELECTRIC Company of Bellefonte, Pa., has been incorporated, with a capital stock of $5,000, to operate in Juniata County. A. J. Musser of Clearfield, Pa., is treasurer.

THE DELAWARE TOWNSHIP ELECTRIC COMPANY of Bellefonte, Pa., has been incorporated, with a capital stock of $5,000, to operate in Juniata County. A. J. Musser of Clearfield is treasurer.

THE MILLER TOWNSHIP ELECTRIC COMPANY of Bellefonte, Pa., has been granted a charter with a capital stock of $5,000 to supply electricity in Perry County. A. J. Musser of Clearfield, Pa., is treasurer.

LAWTON & MONK, INC., of Syracuse, N. Y., have filed articles of incorporation with a capital stock of $25,000 to deal in auto batteries, electrical auto supplies, etc. The incorporators are: L. S. Chapman, W. G. Monk and E. E. Lawton of Syracuse, N. Y.

THE TIP-TOP LIGHTING FIXTURE COMPANY of Brooklyn, N. Y., has been incorporated with a capital stock of $5,000 to manufacture and deal in electric-lighting fixtures, etc., by P. G. Widockler, H. Hoffman and L. Sandak, 535 Graham Avenue, Brooklyn, N. Y.

THE LEISURE ELECTRIC COMPANY of Elwood, Ind., has been incorporated, with a capital stock of $10,000, to supply electricity to the farmers in Duckcreek Township. The incorporators are: B. F. Leisure, O. E. Leisure, I. W. Carr, Harry Sells, D. Wordwell and Arthur R. Hiatt.

PIERCE & SKOGMARK, INC., have filed articles of incorporation with a capital stock of $50,000 to do a general consulting engineering business, electricians, contractors, chemists, etc. The incorporators are: C. U. North, N. Skogmark and F. E. Pierce, 35 Nassau Street, New York, N. Y.

THE CONSUMERS' LIGHT & POWER COMPANY of Ringling, Okla., has been incorporated with a capital stock of $1,000,000 for the purpose of acquiring electric and gas plants and ice factories in that vicinity. William H. Baehr of Chicago, Ill., and others are interested in the company.

THE KRICK ELECTRIC COMPANY of Sinking Spring, Pa., has been granted a charter, with a capital stock of $10,000, to supply electricity for lamps, heaters and motors in Spring Township. The incorporators are: William F. Krick, Dr. H. S. Dissler of Denver, and George J. Root of Reamstown.

THOMPSON & BINGER, of New York, N. Y., have filed articles of incorporation, with a capital stock of $250,000, to do a general contracting, engineering business and electrical work. The incorporators are: E. M. Reufer, 248 Central Avenue, Brooklyn; E. M. James, 2 Rector Street, New York City, and A. R. May, 356 Hooper Street, Brooklyn, N. Y.

THE BLACK RIVER POWER COMPANY has been incorporated by Robert J. Bain, Edward A. Markley and Charles B. Bradley. The company is capitalized at $10,000 and proposes to build dams on the Black River at Hacklebury, in Morris County, and furnish electrical power and water power. The office of the company is located at 243 Washington Street, Jersey City, N. J.

MILWAUKEE ELECTRIC CRANE & MANUFACTURING COMPANY of Milbrook, N. Y., has been incorporated by A. E. Moore, 20 Arden Street; G. F. Jebbett, 120 Sherman Avenue, New York City, and F. H. Butchorn, 764 St. John's Place, Brooklyn, N. Y. The company is capitalized at $335,000 and proposes to manufacture electrical machinery and appliances, electric cranes, hoists, etc.; also mining coal, iron, steel, etc.

THE RAPID CONTROLLER CORPORATION of New York, N. Y., has been incorporated with a capital stock of $120,000 to do a general mechanical engineering business, deal in elevator dispatchers' time recording machines, clocks, etc.; also an electrical engineering business, dealing in apparatus for radio-activity. The incorporators are: P. Cooksey, 126 East Twenty-fourth Street, New York City; J. C. Myers, 122 Hicks Street, Brooklyn, N. Y., and L. Reid, 808 St. Nicholas Avenue, New York City.

## Trade Publications

SOCKETS.—The Arrow Electric Company of Hartford, Conn., is distributing a leaflet descriptive of its Arrow E interchangeable Mogul sockets.

WASHING MACHINE.—The Easiest Way Manufacturing Company of Sandusky, Ohio, is distributing a folder descriptive of its "Easiest Way Home Washer."

CONDULETS.—The Crouse-Hinds Company of Syracuse, N. Y., is distributing bulletin No. 1000 D, descriptive of its safety-first ironclad switch condulets.

METAL COATING MATERIALS.—Hess & Son of Philadelphia, Pa., are distributing a bulletin descriptive of their "Epicassit" for tin, lead and zinc coatings.

LIGHTING FIXTURES.—The Keith Manufacturing Company of Clinton, N. Y., is distributing a leaflet descriptive of its adjustable light fixtures for sewing machines.

STORAGE BATTERIES.—The Electric Storage Battery Company of Philadelphia, Pa., is distributing bulletin No. 164, descriptive of its storage batteries for stationary and semi-portable types for railway signal service.

FANS.—The Sprague Electric Works of the General Electric Company, New York City, is distributing a bulletin descriptive of its direct-current and alternating-current fans.

REFLECTORS.—The National X-Ray Reflector Company of Chicago, Ill., is distributing a bulletin descriptive of its reflectors. The title of this bulletin is "The Magnets of Trade."

MOTORS.—The Sprague Electric Works of the General Electric Company of New York City is distributing bulletin No. 41514, descriptive of its varying-speed single-phase motors, type BSS.

WIRING APPLIANCES.—The Trumbull Electric Manufacturing Company of Plainville, Conn., is distributing a leaflet descriptive of its attachment plug, flush receptacle and side outlet current taps.

TANK BLOCK.—The Laclede-Christy Clay Products Company of St. Louis, Mo., is distributing a small card for wall mounting with the words, "The War 'Tank' Has Nothing on the Glass Tank in Efficiency."

METAL MOLDING.—The National Metal Molding Company of Pittsburgh, Pa., is distributing bulletin No. 151, descriptive of its non-metallic flexible conduit; bulletin No. 350, descriptive of its locknuts and bushings, and bulletin No. 50, descriptive of its rigid steel conduit.

SEW-MOTOR.—The Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., is distributing its campaign book (Small Motors No. 27) printed in two colors, which includes a complete description of all dealers' helps for its sew-motor. Included with the book is a requisition post card on which to order the various sales helps.

## New England States

NEWPORT, VT.—Work will soon begin by the Newport Electric Light Company on the construction of a masonry dam, 600 ft. long and 20 ft. high, near Arnold's Mills, to cost approximately $40,000. About 1000 hp. will be developed.

BARNSTABLE, MASS.—Bids will be received by the Commissioners of Barnstable County, Barnstable, Mass., until April 3 for heating, electric wiring, pumping and water storage, refrigerating apparatus, plumbing and sewage disposal for the County of Barnstable Infirmary buildings in the village of Pocasset, town of Bourne. Separate bids to be submitted on each division of the work. Plans and specifications are on file in the office of James Purdon, architect, 8 Beacon Street, Boston, Mass.

BEVERLY, MASS.—The Beverly Gas & Electric Company has applied to the City Council for permission to place and maintain wires and underground conduits in Hale and Thissell Streets.

WORCESTER, MASS.—The Worcester Electric Light Company is contemplating the purchase of a 20,000-kw. turbine to be installed in the Webster Street plant, which will increase the output of the station to 55,000 kw.

HARTFORD, CONN.—The State Legislature has passed the bill amending the charter of the Housatonic Power Company of New Haven so that it may be taken over by the Rocky River Power Company, subject to the approval of the Public Utilities Commission, and the two consolidated under the name of the Connecticut Light & Power Company. The Rocky River Power Company owns four valuable water rights on the Housatonic River and another one on one of its tributaries. Under the proposed arrangement the company will have the advantage of the flow of the Housatonic River all the way to the Sound. The second advantage lies in the establishment of a steam power plant that will supplement the river during low water periods.

PUTNAM, CONN.—The Legislature has passed a bill authorizing the Putnam Light & Power Company to increase its capital stock to $100,000.

## Middle Atlantic States

BINGHAMTON, N. Y.—The Binghamton Light, Heat & Power Company is building a new power plant at Johnson City. The equipment wil consist of two General Electric turbines, one 5000-kw. and one 3500-kw. and five 500-hp. Babcock & Wilcox boilers. The company has also under construction a 33,000-volt transmission line from the new plant to the proposed substation in Binghamton. P. A. Staples is manager.

GROTON, N. Y.—The proposal to sell the municipal electric-light plant to the Cayuga Power Company is under consideration.

LACKAWACK, N. Y.—The installation of an electric-light plant in Lackawack is reported to be under consideration. J. S. Shields of Lackawack is reported interested.

NEW YORK, N. Y.——Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until April 9 for removal of existing elevator equipment and furnishing and installing a modern electric passenger elevator and operating mechanism at the naval hospital, New York, N. Y. Drawings and specifications (No. 2336) may be obtained at the above bureau or from the commandant of the navy yard, New York, N. Y.

NEW YORK, N. Y.—Bids will be received by the Department of Public Charities, tenth floor, Municipal Building, New York City, until April 4 for furnishing and installing fire signal systems in the various groups of buildings under the jurisdiction of the Department of Public Charities. Blanks and further information may be obtained at the office of Porter & Himmelwright, engineers, Fifth Avenue Building, Manhattan, where plans and specifications may be seen.

NIAGARA FALLS, N. Y.—Application has been made to the Public Service Commission by the Clipps Electric Distributing Company of Niagara Falls for authority to issue $13,200,000 in capital stock to be used to acquire all the common stock of the Hydraulic Power Company of Niagara Falls and also for permission to merge the latter company with the new corporation.

DUNCANNON, PA.—The managers of the municipal electric-light plant are planning to establish a 24-hour service throughout the borough.

ERIE, PA.—Plans are being prepared for the construction of a new power plant for the Erie Lighting Company. Day & Zimmerman, of Philadelphia, are architects.

HARRISBURG, PA.—The Pennsylvania Railroad Company is planning to install an underground system on North Seventh Street to place its overhead wires underground.

HARRISBURG, PA.—The new creamery building and refrigerating plant now being erected by the Hershey Creamery Company, South Cameron Street, will be equipped with electrically operated machinery.

HARRISBURG, PA.—The Harrisburg Light & Power Company is planning to install underground conduits on Pine, Locust, Chestnut and other streets in the business section, at a cost of about $150,000.

HAZLETON, PA.—The Lehigh Valley Railroad Company contemplates the installation of an electric plant in connection with its local repair shops.

MEADVILLE, PA.—Bids, it is reported, will soon be received for addition to boiler room and laundry, to cost about $20,000, for the Independent Order of Odd Fellows' Home. J. W. Yard & Son of Erie are architects.

PHILADELPHIA, PA.—Within the next few weeks arrangements will be made to place contracts for the construction of a power plant for the Philadelphia General Hospital at Byberry Farms. Philip H. Johnson is architect in charge of the city hospitals.

TARENTUM, PA.—Bids will be received by the electric light and water committee of the borough of Tarentum until April 5 for furnishing one 1000-kw. steam turbine generating unit, one surface condenser and auxiliaries. Specifications may be obtained at the office of Sidney B. Martin, consulting engineer, 401 Penn Building, Pittsburgh, Pa.

WILKINSBURG, PA.—Bids will be received by James G. Sansom, secretary of the school board at the Wilkinsburg High School Building, Wallace Avenue, until April 13 for lighting fixtures for the new Horner school building, now under construction. Plans, etc., may be obtained on application to Ingham & Boyd, architects, 323 Fourth Avenue, Pittsburgh.

ASBURY, N. J.—The Atlantic Coast Electric Railway Company is considering the construction of an addition to the boiler room at its power plant and the installation of four Badenhausen boilers, having a total capacity of 2440 hp., stokers, etc.

HACKENSACK, N. J.—The Gas & Electric Company of Bergen County has been granted permission by the Board of Public Utility Commission to issue $500,000 in bonds for extensions and improvements to its system. The company is leased to and operated by the Public Service Corporation of New Jersey.

McAFEE, N. J.—A new crushing plant and electrically driven shovel equipment will be installed at the local limestone quarries of the Bethlehem Steel Company of South Bethlehem, Pa. The proposed plant will be operated by electricity and will cost about $350,000.

NEWTON, N. J.—The Newton Electric & Gas Company will remodel both its electric and gas plants. The gas engine in the electric plants will be replaced with steam turbine generators or purchased power. The electric and gas distributing systems will be rebuilt. Negotiations are under way for a new street-lighting system, which will cover about 100,000 cp. in incandescent lamps, units from 60-cp. to 600-cp. ratings. Paul D. Hawkins is manager.

TRENTON, N. J.—Bids will be received by the City Commission until April 4 for furnishing and installing a conduit and cable system in Mahlon Stacy Park, to be used for operation of street lamps to be installed later. Plans and specifications are on file in the office of the Department of Parks and Public Property.

TRENTON, N. J.—The Westinghouse Lamp Company, it is reported, contemplates the construction of a new power house, 50 ft. by 100 ft., one story high. The Stone & Webster Engineering Corporation, 147 Milk Street, Boston, Mass., has charge of the engineering work.

BALTIMORE, MD.—Plans have been made by the Municipal Electric Commission for an additional system of conduits through Southwest Baltimore to the Westport power house of the Consolidated Gas, Electric Light & Power Company.

BALTIMORE, MD.—The Consolidated Gas Electric Light & Power Company, it is reported, contemplates the erection of a new generating station at Westport, to be known as station "C." The building will be equipped with six 1047-hp. boilers and will be similar in design and construction as stations A and B. The cost of building and equipment is estimated at $500,000.

FAIRMONT, W. VA.—Arrangements have been completed whereby the Monongahela Valley Traction Company of Fairmont will take over the property of the Kanawha Traction & Electric Company of Parkersburg, which operates electric light and power plants, street railways and interurban railways in West Virginia and Ohio.

MARTINSBURG, W. VA.—Extensive improvements are contemplated by the Potomac Light & Power Company of Martinsburg, involving an expenditure of from $150,000 to $200,000. The work will include rebuilding of dam No. 5 and the installation of hydraulic machinery. Emory L. Coblentz of Middletown is president.

NORFOLK, VA.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until April 9 for self-contained refrigerating, piping, connections and accessories necessary for replacing the existing plant in the naval hospital at Norfolk, Va. Drawing and specifications (No. 2335) can be obtained at the above bureau or to the commandant of the navy yard named.

WASHINGTON, D. C., Bids will be received by the Board of Awards, Department of Agriculture, Washington, D. C., until April 3 for furnishing an electric motor for the bureau of animal industry and also for chemical industry. For further information address R. M. Reese, chairman of board of awards.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Puget Sound, Wash., Schedule 857—two forced draft blowers; Schedule 856—one steam steering engine, miscellaneous ventilating fans. Brooklyn, N. Y., Schedule 851—miscellaneous ventilating fans and spares. Mare Island, Cal., Schedule 851-14—ventilating fans and spares. Brooklyn, N. Y., and Mare Island, Cal., 21 disk heaters. Philadelphia, Pa., Schedule 850—one 10-hp. and one 15-hp. motor; Schedule 849—one electric windlass. Application for proposal should designate the schedule desired by number.

## North Central States

ALMA, MICH.—The Central Michigan Light & Power Company, it is reported, contemplates the construction of a power plant on Pine River, to cost about $150,000.

CALUMET, MICH.—The installation of a new street-lighting system, to cost about $75,000, is under consideration. W. E. Smith is reported interested in the project.

DETROIT, MICH.—Work has started on the construction of the proposed buildings and storage yards of the Detroit United Railway Company on the River Rouge, near Detroit. The cost of the work is estimated at $400,000 and will include a machine shop, car shops, foundry, office headquarters and other departments.

SIDNAW, MICH.—The Northern Michigan Power Company, it is reported, will begin work on its Sturgeon development in April. The present plans provide for the construction of two large dams near the headwaters of the Sturgeon River and to develop about 20,000 hp. Several years ago surveys were made for the erection of a transmission line to Houghton. Walter S. Prickett of Sidnaw is interested in the company.

AKRON, OHIO.—Bids will be received at the office of the director of public service of Akron, Ohio, until April 18 for furnishing turbo-centrifugal pumps as follows: Item 1—High lift unit; one horizontal steam turbine reduction gear-driven centrifugal pumping unit complete with water-works type condenser and auxiliaries, normal capacity of 10,000,000 gal. daily capacity against a total head of 220 ft.; Item 2—Low lift unit: One horizontal steam turbine reduction gear-driven centrifugal pumping unit, normal capacity of 25,000,000 gal. daily against a total head of 12 ft. The city will furnish foundations. Specifications may be obtained from the Engineering Department, Water Works office, 102 East Mill Street, Akron, Ohio, upon deposit of $5. G. G. Dixon is engineer.

CINCINNATI, OHIO.—Bids, it is reported, will soon be asked by W. Baldwin, care of Union Distilling Company, Third and Race Streets, Cincinnati, for addition to power plant.

DILLONVALE, OHIO.—The Sunnyside Electric Company contemplates extending its electric transmission line from Dillonvale to Amsterdam, a distance of 25 miles.

## *Construction*

**News of Projects, Plans, Bids and Contracts. Notes on Work Under Way**

FINDLAY, OHIO.—The Findlay Steel Castings Company has purchased the plant of the Grant Motor Company and, it is understood, will install equipment for manufacturing castings by the use of electrical energy. E. J. Edwards of Detroit, Mich., is president of the company.

MARIETTA, OHIO.—The City Council has adopted an ordinance providing for the purchase of a new boiler for the municipal electric-light plant, the cost not to exceed $1,500.

MARION, OHIO.—The Fairbanks Steam Shovel Company of Marion is planning to erect a steel foundry, 62 ft. by 300 ft. A power plant will also be erected which will be equipped with a 1000-hp. engine and an 800-kw. generator.

NEWTON FALLS, OHIO.—The Village Council has passed an ordinance authorizing an issue of $5,300 in bonds for the installation of an electric-incandescent street-lighting system.

OBERLIN, OHIO. — Investigations are being made by W. F. Shikler, engineer, for the City Council as to the advisability of establishing a municipal electric-light and power plant. The contract with the Oberlin Gas & Electric Company expires in 1920.

RAVENNA, OHIO.—The City Council is considering the installation of a new street-lighting system at the expiration of the present contract with the Ravenna Gas & Electric Company next June. R. Z. Kirk is resident manager of the company.

COVINGTON, KY.—The City Commissioners are considering an ordinance compelling all public service corporations to place their wires underground in the business section of the city.

PADUCAH, KY.—Additional equipment, it is reported, will be purchased for the municipal electric-light plant, including two 300-hp. water-tube boilers and two 60-cycle, three-phase generators directly connected to non-condensing engines.

FORT WAYNE, IND.—The Board of Public Works, it is reported, has rejected all bids submitted for a 5000-kw. generator for the municipal electric plant and has decided to install a 3000-kw. turbine instead. Bids for the 3000-kw. machine will soon be asked for.

LEISURE, IND.—The Leisure Electric Light Company, recently incorporated with a capital stock of $10,000, is planning to erect an electric transmission line from Elwood to Leisure, a distance of 6 miles, to secure energy from the Indiana General Service Company. The electric company proposes to distribute electricity for lamps and motors to the farmers of Duckcreek Township.

NEW CASTLE, IND.—Work has begun on the reconstruction of the distributing system of the Inter-State Public Service Company, which was put out of commission by the recent tornado in central Indiana.

WALKERTON, IND.—The Plymouth Electric Light & Power Company, it is reported, has submitted a proposal to the Council offering to purchase the municipal electric-light plant in Walkerton.

ANCHOR, ILL.—Steps have been taken to organize a company under the name of the Anchor Electric Light Company to construct and operate an electric-light plant. Edward Riecks, Frederick A. Riecks, Jr., and Hedweg Riecks are interested.

CULLOM, ILL.—Work has started on the construction of a new power house, 25 ft. by 60 ft., by the Cullom Electric Company. The new power plant will be driven by oil engines. The company will also rebuild its distribution system. Arthur G. Walter is secretary and treasurer.

DE KALB, ILL.—The City Council is considering engaging an electrical engineer to prepare plans for the ornamental lighting system for the Horse Shoe addition.

ELKVILLE, ILL.—The local electric-light plant has been purchased by the Central Illinois Public Service Company of Mattoon. The Elkville plant will be abandoned and energy transmitted from Carbondale, 13 miles distant, as soon as the high-tension transmission line is completed.

HILLSBORO, ILL.—Plans are nearly completed, it is reported, for construction of a section of the proposed interurban electric railway between Pawnee and Hillsboro. Owing to the high cost of copper wire, gas-electric cars will be used instead of trolley cars.

KEITHSBURG, ILL.—The installation of a municipal electric-light plant in Keithsburg is reported to be under consideration.

METROPOLIS, ILL.—Bonds to the amount of $82,000 have been voted for extensions and improvements to the municipal electric-light plant and water-works system.

MONTGOMERY, ILL.—Plans have been prepared for the construction of a power plant on Fox River for the Montgomery Hydro-Electric Power Company. H. A. Strauss, 11 West Monroe Street, Chicago, Ill., is engineer.

MOUNT VERNON, ILL.—The property of the Citizens' Gas & Electric Company is reported to have been purchased by the Southern Illinois Light & Power Company of Hillsboro. Improvements, it is understood, will be made to both plants.

PEORIA, ILL.—Various franchises of the Peoria & Chillicothe Electric Railway Company have been submitted to the Public Utilities Commission for approval. If present franchises prove satisfactory work will begin on the proposed line as soon as the weather permits. The company will build a power plant at Rome. E. S. Woolner of Peoria is president.

QUINCY, ILL.—Bids will be received by the Commissioners of the Indian Grave Drainage District at the office of L. H. A. Nickerson, secretary, Quincy, until May 1, for construction and equipment of a drainage pumping plant, consisting of a brick building, equipped with one 54-in. and one 36-in. centrifugal pump to be driven by electric motors, oil engines or steam engines. Plans may be obtained upon application to W. P. Bushnell, engineer, Quincy, upon the deposit of $10.

ROCK ISLAND, ILL.—Bids will be received at the Rock Island Arsenal, Ill., until April 5 for furnishing one hydraulic turbine unit complete and one additional curb ring.

BRODHEAD, WIS.—The Council is considering the reconstruction of the municipal electric-light plant at a cost of about $20,000.

KILBOURNE, WIS.—The Wisconsin Gas & Electric Company is reported to be securing the right of way for the erection of an electric transmission line from Lake Mills to Marshall.

MONROE, WIS.—The installation of an ornamental street-lighting system is under consideration by the Council.

MONTICELLO, WIS.—At an election to be held April 3 the proposal to issue $12,000 in bonds for improvements to the municipal electric-light plant will be submitted to the voters.

PORTAGE, WIS.—The City Council is considering the installation of an ornamental lighting system in the business district.

STEVENS POINT, WIS.—The Wisconsin Valley Electric Company is contemplating the erection of an auxiliary transmission line from Stevens Point to Mosince.

WONEWOC, WIS.—Plans are being considered by the Wonewoc Power Engineering Company, 51 Corn Exchange, Minneapolis, Minn., for the construction of a hydroelectric plant, including repairs to gates at dam, a power house, a 50-kva. generator, and an auxiliary plant, equipped with internal combustion engine.

BLOOMING PRAIRIE, MINN.—The L. G. Campbell Manufacturing Company has recently installed a 125-hp. boiler and contemplates the installation of an additional engine and generator soon. George Upcraft is superintendent.

CHISHOLM, MINN.—Bids will be received by William Ritchel, clerk of Independent School District No. 40, Chisholm, until April 18 for additions and alterations of the old High School building, separate bids to be submitted on general contract, plumbing, electrical work, heating, ventilating, sheet metal, temperature fans, motors and heaters, vacuum heating system, and air washers. Plans and specifications may be obtained at the office of William Ritchel, clerk, Chisholm, and at the office of Tyrie & Chapman, architects, 320 Auditorium Building, Minneapolis, Minn., upon deposit of $15 for general contract and $10 for each of the other divisions of the work.

LANCASTER, MINN.—An election will be called to submit to the voters the proposal to issue $8,000 in bonds for the installation of an electric-lighting system.

ST. VINCENT, MINN.—James Kneeshaw is contemplating installing an electric-light plant at his farm in the near future.

WINONA, MINN.—The installation of a municipal electric-lighting plant in Winona is under consideration. W. P. Murphy is chairman of lighting committee.

CEDAR RAPIDS, IOWA.—The City Council has authorized electric lamps to be erected along the main drives in Ellis Park and Daniels Park.

CLARINDA, IOWA.—The property of the Lee Light & Power Company of Clarinda has been purchased by the Continental Gas & Electric Corporation of Cleveland, Ohio.

ELKADER, IOWA.—Schmidt Brothers & Company have been granted a franchise to erect and operate electric transmission lines in Clayton and Delaware Counties for a period of 25 years. The company proposes to extend its lines to Boardman, Cox Creek, Volga and Mallory townships and to the towns of Littleport, Garber, Elkport and Colesburg.

OTTUMWA, IOWA.—Preparations are being made for improvements to the power plant of the Ottumwa Railway & Light Company, including the installation of a 1250-kw. turbo-generator and auxiliaries.

COLE CAMP, MO. — The City Electric Company has purchased two Mogul oil engines, one 50 hp. and the other 25 hp., directly connected to jackshaft by friction clutches. A new building is now being erected and will be completed in about 30 days. D. C. Intelman is proprietor.

ELDON, MO.—At an election to be held April 3 the proposal to issue bonds for the installation of a municipal electric-light plant will be submitted to the voters.

KANSAS CITY, MO.—Bids are being asked by C. B. Sloan, architect, 321 East Eleventh Street, Kansas City, for the erection of a storage building, 55 ft. by 81 ft., five stories, and a garage, 30 ft. by 55 ft., one story, to cost about $40,000, for the Monarch Transfer & Storage Company.

KANSAS CITY, MO.—Bids will soon be asked by Smith, Rea & Lovitt, Finance Building, Kansas City, Mo., architects, for electric wiring for business building and theater, to be erected at Thirty-first Street and Troost Avenue, to cost about $170,000, for J. C. Wirthman, Eighteenth Street and Troost Avenue.

MACON, MO.—A petition is being circulated asking the Town Board to call an election to vote on the proposal to issue $5,000 in bonds to erect a transmission line and install an electric-lighting system in Macon.

ST. LOUIS, MO.—The Union Electric Light & Power Company is planning to erect a substation at Broadway and Osage Street, South St. Louis. The station will have an ultimate capacity of 15,000 kw. and will receive electricity at 13,200 volts from the Ashley Street plant which it will step down to 2400 volts for distribution. The company will erect a high-tension transmission line from the new station to Continental, 3 miles distant, and to Festus, a distance of 30 miles. Space will also be provided for street-lighting equipment in the substation. The cost of the work is estimated at $200,000.

UNIONVILLE, MO.—One 37½-hp. Fairbanks-Morse oil engine and a 30-kva. Fairbanks-Morse generator have been purchased for the municipal electric-light plant, which will be installed about July 1. M. Flynn is superintendent.

INDIANOLA, NEB.—At an election to be held April 3 the proposal to issue $14,000 in bonds for the construction of an electric-lighting system and the erection of a transmission line, 12 miles long, will be submitted to the voters.

STELLA, NEB.—The oil engine in the local plant of the Nebraska Gas & Electric Company was recently destroyed by an explosion.

ALTOONA, KAN.—At an election to be held April 2 the proposal to issue $15,000 in bonds for the installation of a municipal electric-light plant will be submitted to the voters.

BALDWIN, KAN.—An election will be held in April to submit to the voters the proposal to issue $20,000 in bonds for rebuilding the municipal electric-light plant and water-works system.

CHERRYVALE, KAN.—Plans are being prepared, it is reported, for construction of a generating station for the Cherryvale Electric Company, to cost about $7,000. F. F. Fletcher, 112½ Myrtle Street, Independence, is architect.

ELLIS, KAN.—The proposal to issue $10,000 in bonds for improvements and extensions to the municipal electric-light plant will be submitted to the voters on April 2.

IRVING, KAN.—The Council is considering a bond issue of $7,000 for the construction of an electric distributing system and the erection of a transmission line to Blue Rapids.

TOPEKA, KAN.—The Legislature has appropriated $75,000 for rebuilding the east wing of the State House and carrying out the scheme for lighting the dome. Contracts for flood-lighting the State House dome will soon be let. Not less than sixty large reflectors will be used. The present lighting system in the State House will be removed and a new system of indirect lighting will be installed. Charles Chandler is state architect.

WICHITA, KAN.—The Kansas City Gas & Electric Company, it is reported, is asking for bids on switchboard equipment, four 1350-kva., four 750-kva. and two 3000-kva. transformers. Contracts have recently been awarded by the company for

addition to power house, one 10,000-kw. turbine, two 550-hp. boilers, condensing equipment, etc. Sargent & Lundy, 72 West Adams Street, Chicago, Ill., has charge of the engineering work.

## Southern States

CARY, N. C.—Contract has been awarded by the city of Cary to Tucker & Laxton of Charlotte for the erection of an electric transmission line to connect with the lines of the Carolina Power & Light Company of Raleigh.

CHARLESTON, S. C.—About July 1 the Charleston Consolidated Railway & Lighting Company expects to have in operation the new substation equipped with three 750-kva. 2300/13,200-volt transformers; also three 400-kva. 2300/6600-volt transformers. In connection with this station the company will erect a three-phase, 60-cycle, 13,200-volt transmission line, 2 miles long, to connect with its present line at North Charleston, now 6600 volts, but to be changed to 13,200 volts. By the end of the year the company expects to have in operation in the power house an additional 528-hp. Franklin boiler. John G. Felton is superintendent of electrical department.

FOUNTAIN INN, S. C.—The city of Fountain Inn has engaged John N. Ambler of Winston-Salem, N. C., to prepare plans for electric-light plant, water works and sewer system.

EASTMAN, GA.—The property of the Eastman Light & Ice Company is reported to have been purchased by Marshall & Company (bankers) of Boston, Mass. Extensive improvements to the system, it is said, are contemplated by the new owners.

FELLSMERE, FLA.—The City Commissioners are considering the installation of an electric light plant, the equipment to consist of a 50-hp. oil engine and generator.

JACKSONVILLE, FLA.—Bids will be received by the Board of Port Commissioners, Realty Building, Jacksonville, until April 7 for furnishing material and installing electric transmission lines in conduit in both steel warehouses at the municipal docks and terminals on Talleyrand Avenue; main lines to be approximately 1700 ft. total length, suitable for transmitting 50 hp., three-phase current at 220 volts and with branches having outlets for connecting portable motors. J. C. O'Dell is manager.

NEW PORT RICHEY, FLA.—Plans are being considered to enlarge the municipal electric-light plant and water-works system. George R. Sims, president of the Port Richey Company, is reported interested.

WAUCHULA, FLA.—The Wauchula Light & Power Company is reported to be considering the installation of two additional generating units, consisting of 100-kw. (each), 60-cycle, 23,000-volt generators directly connected to high-speed engines. E. L. Dunn is general manager.

WATERTOWN, TENN. — Arrangements have been made whereby the local electric-lighting system will be extended to Alexandria to furnish electrical service in that town.

BIRMINGHAM, ALA.—Within the next few months the Birmingham Railway, Light & Power Company expects to install three new 1000-kw. rotary converters.

JASPER, ALA.—The property of the Jasper Water, Light & Power Company has been purchased by Weakley & Fies of Birmingham. The new owners will develop and improve the property.

BEARDEN, ARK.—The City Council has granted the Bearden Electric Light Company a franchise to construct and operate an electric-light plant in Beardon.

McGEHEE, ARK. — Improvements are being made to the municipal electric-light plant, which will double the output of the station and include remodeling the power station, the installation of an additional 120-hp. Diesel engine, one 100-kw. General Electric alternator with necessary switchboard apparatus, etc. H. W. Wright is manager.

GLENMORA, LA.—The Glenmora Light & Power Company is planning to install an additional 15-hp. crude-oil engine and install 20 more street arc lamps in about 90 days. The company is also considering the installation of a 10-hp. three-phase, 60-cycle motor with a 100-gal. per-minute pump in the latter part of the year. F. P. Joseph is manager.

KENNER, LA.—Bids will be received at the office of the Mayor and Board of Aldermen of Kenner until April 9 for lighting the town and furnishing electricity for lamps and motors for commercial, residential lighting and other purposes.

NEW ORLEANS, LA.—The contract for electric work in connection with the construction of the Elks' Home has been awarded to the Douglas Electric Construction Company, 626 Julia Street, New Orleans, by John Thatcher & Son, 60 Park Avenue, Brooklyn, N. Y., general contractor. The cost is estimated at $12,000.

BUTLER, OKLA.—At an election to be held April 3 the proposal to issue $6,000 in bonds for the installation of a municipal electric-light plant will be submitted to the voters.

COVINGTON, OKLA.—The City Trustees have granted a franchise to private parties to construct and operate an electric-light plant in Covington.

SKIATOOK, OKLA.—As soon as estimates of cost of improvements to the electric-light system can be obtained the Board of Trustees will call an election to vote on the proposal to issue bonds for same.

STRATFORD, OKLA.—The installation of a municipal electric-light plant and water-works system in Stratford is under consideration.

HOUSTON, TEX.—The Ship Channel Transportation Company, recently organized with a capital stock of $60,000, proposes to construct an interurban railway from Houston to Goose Neck. E. Kennedy of Houston and L. B. Mitchell of Chicago, Ill., are reported interested.

## Pacific and Mountain States

CHARLESTON, WASH.—The City Council has appointed a committee to make arrangements for the purchase of the local system of the North Pacific Public Service Company. The city will purchase electricity and operate the system.

COLLVILLE, WASH. — The Stevens County Power & Light Company, which recently completed its new plant at Myers Falls, has placed an order for an additional generating unit to meet the increasing demand for electrical service.

EPHRATA, WASH.—The Nelson lighting system, which supplies electrical service in Ephrata, is to be enlarged and the transmission lines extended to Soap Lake. The cost of the proposed improvements is estimated at $10,000.

HOQUIAM, WASH.—The City Council is considering calling a second election to submit to the voters the proposal to take over the present electric-light and power plant and distributing system in Hoquiam or to construct a new plant.

NORTH YAKIMA, WASH.—The Commissioners of Yakima County have granted the Pacific Power & Light Company a franchise to erect electric transmission lines on 7 miles of county roads for a period of 50 years.

TACOMA, WASH.—The Tacoma Railway & Power Company has been granted a franchise to erect electric transmission lines from the Pierce County line to the A. L. Brown farm, near Nisqually, to serve farmers in that district.

KLAMATH FALLS, ORE.—The California-Oregon Power Company has leased the Keno irrigation canal from the United States Government for a period of 10 years. The lease provides for improvements to be made by the company and also permits the erection of a dam at the head of Link River, if the company so elects, the dam to revert to the government. Alex Rosborough is vice-president.

PORTLAND, ORE.—The contract for the complete electrical installation of the proposed shipbuilding plant to be erected by the Columbia Shipbuilding Corporation in South Portland has been awarded to the Morrison Electric Company, 109 West Park Street, at about $40,000.

BISHOP, CAL.—Preparations are being made by the Round Valley Tungsten Company for the installation of an electric furnace for the purpose of manufacturing ferro-tungsten.

FRESNO, CAL.—Work will soon begin on the erection of a new substation for the San Joaquin Light & Power Company at Jensen and Cornelia Streets, to cost about $15,000. The company is now erecting an auxiliary transmission line to supply electricity to operate the pumping plants in the Kerman region.

LOS ANGELES, CAL.—Plans are being considered by the Great Western Milling Company, Ninth and Alameda Streets, Los Angeles, for the construction of an addition to its plant, 50,000 sq. ft., to cost about $200,000. All machinery in the new plant will be equipped with electrically driven machinery. H. E. Woolner is president.

SAN FRANCISCO, CAL.—The State Railroad Commission has authorized the Trinity Gold Mining & Reduction Company to sell to the California-Oregon Power Company its hydroelectric plant, including the transmission and distribution system, near Carrville, for $22,000. The power company has extended its transmission line from Caste to Trinity Center and proposes to use the Trinity County's plant as an auxiliary.

BOISE, IDAHO.—Bids will be received at the office of the supervising architect, Treasury Department, Washington D. C., until May 11, for a new system of conduit and wiring and alterations in heating system in the United States assay office at Boise, Idaho. For details see proposal columns.

SALT LAKE CITY, UTAH.—Surveys are being made for the route for a proposed addition to the transmission line of the Utah Power & Light Company between Salt Lake City and Grace, Idaho, a distance of 130 miles. The cost of the line is estimated at about $300,000.

GLOBE, ARIZ.—The output of the hydroelectric power plant of the Salt River irrigation project, built in connection with the Roosevelt Dam, it is understood, will be increased to 25,000 hp. The Salt River Valley Water Users' Association, which is composed of land owners embraced in this system, is promoting the construction of a dam across the Verde River, about 80 miles below the stream's junction with the Salt River. The proposed dam will cost about $1,000,000 and the water storage will enable the reclamation of about 40,000 additional acres. The association also has in view the utilization of the water power at Horse Shoe Bend on Salt River, about 20 miles below the Roosevelt Dam, which it is estimated will develop about 20,000 hp. This plant would be made a part of the Roosevelt Dam system.

PRESCOTT, ARIZ.—The Arizona Power Company has entered into a contract with the Consolidated Smelting Company to furnish a minimum of 1000 hp. for a period of three years. The company has also closed a contract with the Gadsden Company and has made new contracts with the Jerome Victor Extension and the Verde Combination companies.

POPLAR, MONT.—The City Council has decided to call a special election to vote on the proposal to grant a franchise for the installation of an electric-lighting system in Poplar.

BURNS, WYO.—Plans are being prepared by C. C. Carlisle of Cheyenne for the installation of a municipal electric-light plant.

THERMOPOLIS, WYO.—During the coming summer a complete electric light and water system will be installed on the State Reservation. The contract for the work, including machinery, pumps, generators, etc., it is understood, has been awarded to the Hendrie-Bolthoff Manufacturing & Supply Company of Denver, Col., at a cost of between $14,000 and $15,000. The cost of the entire work is estimated at about $25,000.

PUEBLO, COL.—The electric-light plants at Ordway and Sugar City have been purchased by the Arkansas Valley Railway, Light & Power Company of Pueblo. A new district will be formed by the company to include Olney Springs, Crowley, Ordway and Sugar City with headquarters at Ordway. Improvements will be made to both plants. The extension of the electric transmission line from Avondale to Boone and thence to the ranch of the Thatcher Cattle Company, 11 miles long, where electricity will be furnished for a 400-acre irrigation project, is contemplated by the company. A street-lighting system may be installed at Boone.

HANOVER, N. M.—The Hanover Bessemer Iron & Copper Company, it is reported, will rebuild its mill and power plant, which was recently destroyed by fire, causing a loss of about $100,000.

## Canada

MEDICINE HAT, ALTA.—The installation of a new street-lighting system is under consideration by the City Council. Single lamp standards mounted with nitrogen lamps, maintained by underground wires, are being considered. G. R. Taylor is superintendent.

NEW WESTMINSTER, B. C.—A permit has been taken out by the Brunett Saw Mills Company for construction of an engine and boiler house.

PENTICON, B. C.—A power development to cost about $60,000 is under consideration by the town of Penticon. The equipment will include a 250-hp. Diesel engine, two generators, etc. F. L. McKeever is engineer.

OTTAWA, ONT.—A bill has been passed by the Private Bills Committee of the

Legislature authorizing the city of Ottawa to expend $1,500,000 without submission to the ratepayers. Among the proposed work is included the construction of an electric power plant for the Lemieux Island pumping plant, to cost about $250,000.

STAMFORD, ONT.—The Township Council has granted the Ontario Hydro-Electric Power Commission permission to make certain extensions to its system in Stamford. The Council has entered into a contract with the Commission for 400 hp. to be used by the township for street lighting and other purposes.

LEVIS, QUE.—At an election to be held in April the proposal to construct a 1,500,000-gal. reservoir and a centrifugal pump, with an electric motor on one side and a steam-driven turbine on the other side, to cost about $75,000, will be submitted to the ratepayers. C. C. Lessard, 147 Cote de la Montagne, Quebec, is city engineer.

MONTREAL, QUE.—Work has been started on the construction of a new foundry, 52 ft. by 200 ft., one story high, for the Thomas Davidson Manufacturing Company in Montreal. The building, 20 ft. by 150 ft., will be equipped with two motor-generator sets, etc., to furnish electricity to operate the electric furnaces. Four 6-ton electric furnaces will be installed in the main building. A 20-ton overhead crane will be erected in the main bay.

## Miscellaneous

MATANZAS, CUBA.—The Compania Anonima Eléctrica Alemana-Cubana of Havana is erecting a new power house in Matanzas, to be equipped with a 1000-hp. Nordberg steam engine, one 1000-hp. Babcock & Wilcox boiler and one Burke Electric Company direct-current, three-wire generator. D. M. Moya, 21 Santa Teresa, Matanzas, is local manager.

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until April 14 for furnishing Babbitt metal, bronze, brass tubing, sheet, sheet copper, pinions, steel cable, electric cable, wire, etc., under circular (No. 1134). Bids will also be received until April 6 for furnishing bolts, cable, tool steel, cable thimbles, screw shackles, wire, hydraulic gages, air whistles, etc., under circular (No. 1133). Blanks and general information relating to these circulars may be obtained at the above office or the offices of the assistant purchasing agent, 24 State Street, New York, N. Y., and 614 Whitney-Central Building, New Orleans, La.; also from the United States Engineer offices in the principal cities throughout the United States.

---

1,219,430. Starting Device for Internal-Combustion Engines; William W. Dean, Chicago, Ill. App. filed Nov. 15, 1912. Improvements.

1,219,432. Selenium Bridge and Method for Making Same; Fay C. Brown, Berkeley, Cal. App. filed July 2, 1916. Object is to produce a light selenium bridge of greatly increased sensitiveness.

1,219,450. Insulator; Frank F. Fowle, Chicago, Ill. App. filed March 25, 1911. Improvements.

1,219,459. Telephone Mouthpiece; Seth M. Hino, Lander, Wyoming. App. filed Aug. 29, 1916. Antiseptic.

1,219,466. Method of Manufacturing Metal Articles by Deposit; Henry C. Kirk, Jr., Roland Park, and George H. Dumler, Baltimore, Md. App. filed June 3, 1915. Improvements.

1,219,470. Electric Switch; George N. Lemmon, Greensburg, Pa. App. filed Feb. 1, 1915. Means of securing contact between a solid metal surface and a metallic flexible brush opposed thereto.

1,219,497. Incandescent Lamp Socket; Martin V. Smith, Hartford, Conn. App. filed July 17, 1915. Improvements.

1,219,517. Testing System; Ray Seth Wilbur, Jersey City, N. J. App. filed July 6, 1914. Measures the capacity of line wires so as to determine the approximate location of faults therein.

1,219,518. Igniting and Lighting Generator; James M. Wilson, Newark, N. J. App. filed April 17, 1914. Improvements.

1,219,519. Automatic Switching Mechanism; James M. Wilson Newark, N. J. App. filed Aug. 26, 1915. Used in connection with generators.

1,219,520. Electric Generator; James M. Wilson, Newark, N. J. App. filed Oct. 8, 1915. Improvements.

1,219,522. Telegraph System; John E. Wright, New York, N. Y. App. filed Jan. 15, 1916. Improves the character and carrying quality of the signal impulses of current sent over telegraph lines.

1,219,524. Electric Railway System; Andrew Yurow, New York, N. Y. App. filed Oct. 15, 1915. Improvements in current-supplying rails of electric railways of the underground conduit type.

1,219,528. Block Signal System; Harry W. Balcom, Worcester, Mass. App. filed April 3, 1915. Single-line wire is used to connect the signals at opposite ends of the block.

1,219,531. Telephone Line Disconnector; Milton S. Bricka, Milan, Ind. App. filed Aug. 23, 1912. For cutting out telephones or other electrical apparatus.

1,219,548. Electric Switch Mechanism; David D. Gordon, Chicago, Ill. App. filed June 8, 1916. For use in electric lamp sockets or the like.

1,219,550. Antenna Structure on Aeroplanes for Wireless Signaling; Walter Hahnemann, Kitzeberg, Kiel, Germany. App. filed Jan. 13, 1915. Increases the range over which wireless waves may be transmitted from and received by an operator on the aeroplane.

1,219,554. Electric Signaling System; Robert J. Hewett, Westfield, N. J. App. filed Dec. 24, 1910. Designed for use on roads where track circuits are employed to control the signals.

1,219,561. Quadruplex Telegraph; Isidor Kitsee, Philadelphia, Pa. App. filed Dec. 30, 1916. Submarine cables.

## *Record of Electrical Patents*

Notes on United States Patents issued on March 18, 1917

1,219,562. Electric Fan and Generator; Haroutinum K. Kouyoumjian, Cleveland, Ohio. App. filed Dec. 23, 1912. For motor vehicles.

1,219,563. Motor Vehicle Construction; Haroutium K. Kouyoumjian, Cleveland, Ohio. App. filed July 19, 1913. Cooling system.

1,219,564. Electric Generator; Haroutium K. Kouyoumjian, Cleveland Ohio. App. filed Aug. 5, 1913. Inherently and automatically self-regulating.

1,219,565. Commutator Construction; Haroutium K. Kouyoumjian, Cleveland, Ohio. App. filed Dec. 18, 1913. Occupies a minimum of space axially in the motor.

1,219,569. Starting Mechanism for Hydrocarbon Engines; Albion D. T. Libby, Orange, N. J. App. filed April 12, 1913. For engine used in an automobile.

1,219,587. Telephone Exchange System; John Newberry Reynolds, Greenwich, Conn. App. filed March 4, 1915. Line testing in telephone exchange systems.

1,219,617. Galvanometer; William Herbert Apthorpe, Cambridge, England. App. filed Aug. 14, 1914. Conducting fiber is maintained in a magnetic or electrostatic field and its movements observed or recorded when a current passes therethrough.

1,219,620. Telephone Instrument; Frederick E. Bentley, Maplewood, Mo. App. filed Nov. 29, 1915. Adapted to operate as a loud-speaking telephone in which the receiver and transmitter are structurally combined in a unitary instrument.

1,219,629. Method of Forming Electrical Heat Units; Ransom W. Davenport, Detroit, Mich. App. filed April 8, 1915. Embedded resistor type.

1,219,632. Connector for Electrical Conductors; Ernest B. Fahnestock, Plandome, N. Y. App. filed Sept. 22, 1914. Improvements.

1,219,648. Electricity Meter; Robert C. Lanphier, Springfield, Ill. App. filed Jan. 8, 1914. Mercury motor meters.

1,219,650. Electric Toaster; Edwin N. Lightfoot, New York, N. Y. App. filed Dec. 26, 1912. Improvements.

1,219,656. Telephone System; Talbot G. Martin, Chicago, Ill. App. filed March 17, 1913. Semi-automatic type.

1,219,666. Signaling System; Harry O. Rugh, Chicago, Ill. App. filed April 8, 1916. Railway.

1,219,671. Device for Aiding the Hearing; Eugene W. Schneider (deceased), late of New York, N. Y. App. filed Sept. 9, 1916. Simplified rheostat.

1,219,679. Electric Barometer Switch; Peter Ernest Stoft, New York, N. Y. App. filed April 25, 1916. Improved means for actuating the switch when the temperature rises to the predetermined point.

1,219,700. Telephone Exchange System and Apparatus Therefor; Albert M. Bullard, New York, N. Y. App. filed July 17, 1906. Improved organization of circuits and apparatus whereby a line to which connection is desired may be selected with speed and accuracy.

1,219,704. Ignition System; Frank Conrad, Pittsburgh, Pa. App. filed Aug. 16, 1916. In connection with internal-combustion engines.

1,219,713. Trolley Retriever; Austin D. Eberly, Spokane, Wash. App. filed March 13, 1916. Prevents a trolley from causing damage when it leaves the wire.

1,219,723. Pneumatic Alarm System; Frank T. Gracey and Thomas W. Lander, Eddyville, Ky. App. filed Aug. 10, 1916. For operating a plurality of alarms in certain cases of emergency, such as fire, burglary, etc.

1,219,727. Telephone Repeating System; Elwood Grissinger Buffalo, N. Y. App. filed June 3, 1916. Provides telephone repeaters in which the difference in phase between the exciting force (represented by speech waves) and the displacement of the vibratory system is controlled within a desired range.

1,219,732. Trolley Wire Hanger; Robert F. Hamilton, Wheeling, W. Va. App. filed Aug. 27, 1915. Improvements.

1,219,746. Insulator Bracket; Lewis F. Keppler, Harlan, Iowa. App. filed Aug. 6, 1915. Made entirely of metal.

1,219,820. Vincent K. Johnson, Indianapolis, Ind. App. filed May 8, 1916. Adapted to remove ice and sleet rapidly.

1,219,888. Combined Receiver and Detector for Wireless Use; Frank Wallberg, New York, N. Y. App. filed Sept. 21, 1915. Detector bridges across the terminals of the electromagnet of the telephone receiver and is mounted within the casing of the receiver just under the diaphragm.

1,219,952. Alternating-Current Motor; Willem C. Korthals-Altes, Schenectady, N. Y. App. filed April 11, 1916. Improved polyphase, alternating-current commutator motor of the brush-shifting type having compound excitation.

1,219,955. Quadruplex Telegraph; Isidor Kitsee, Philadelphia, Pa. App. filed Dec. 30, 1916. Simple arrangement for transmitting two messages simultaneously.

1,219,957. Burglar Alarm; Theophil Koschade, North Adelaide, South Australia. App. filed Feb. 12, 1914. Improvements.

1,219,961. Means for Indicating Electrical Characteristics of Alternating Currents; Irving Langmuir, Schenectady, N. Y. App. filed July 20, 1914. Invention relates to apparatus of the type known as the Braun tube.

1,219,965. Plate Holder for X-Ray Exposures; Henry G. Leisenring, San Diego, Cal. App. filed May 2, 1916. Takes one or more, preferably four, exposures in quick succession.

1,219,966. Electrolytic Gas Generator; Isaac H. Levin, Newark, N. J. App. filed Nov. 18, 1916. Designed to produce hydrogen and oxygen gases.

1,220,005. Wireless Signaling System; James Harris Rogers and Henry H. Lyon, Hyattsville, Md. App. filed Nov. 10, 1916. Improvements.

1,220,072. Method of Wireless Signaling; Louis Cohen, Washington, D. C. App. filed Nov. 13, 1915. Interrupting the current in a high-frequency oscillatory circuit for wireless signaling purposes.

1,220,152. Fuse Device; Nicholas J. Conrad, Chicago, Ill. App. filed April 4, 1914. Adapted for extra-high-potential service.